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GOVERNMENT AND WIRELESS.

Elsewhere we print a newspaper account of the Government wireless situation at the present moment, which is illuminating as to the bureaucratic spirit that would have full play in case the Government should decide to assume complete control of a coast line wireless service. It appears that four of the cabinet departments has each its pet wireless system; that three of these are in a struggle to obtain control of the coast line service, and that at least one—the Navy Department—demands exclusive control to the elimination of any stations established by private enterprise. The plan of the latter department is, it seems, to divide the coast into zonal districts of 240 miles, yet according to the correspondent, the system which it champions—that of the German Emperor's court jester—is effective over only 70 miles. The pretence put forth—evidently to appeal to the jingo spirit—is that in time of war national defence will demand that the coastwise wireless service shall be under military control, and that this emergency must be provided for through the organization and administration in times of peace of such service on a military basis. That wireless telegraphy will in future wars play a leading part is undoubtedly true, and for that very reason the art should be permitted the freest possible development in order that it may prove of the greatest possible service when called to war duty. That such development would occur under military domination none, we believe, will seriously assert; and assuming that war periods are to continue to be short in comparison with intervening times of peace, the only proper course open is to encourage in every possible way the inventor, and to place no trammels on development through commercial enterprise, the only limitation being such restrictions as the matter of ethereal interference calls for. And the administration of such restrictions as may be necessary on account of this latter feature of wireless telegraphy would undoubtedly come more naturally under the cognizance of the Department of Commerce and Labor than under any of the departments now battling for that privilege. Under conditions of untrammeled development a wireless coastwise service would, in time of peace, grow up normally, and in time of war could temporarily, with its personnel, be turned over to one of the military departments, and give infinitely better service than an organization fostered as proposed. As to the probable result of naval control, we need only point to the humiliating rank the Naval Observatory holds among similar establishments in this country and throughout the world.

NEW SUBMARINE CABLES.

Whatever may be the ultimate results with wireless telegraphy, it is evident that submarine cable managers and promoters are pursuing their way unterrified. The Frankfurter *Zeitung* now announces that German and Dutch capitalists are to do the financing of a cable from the Dutch Island of Menado Tua, off the coast of Celebes, East Indies, to the American Island of Guam, and thence to Shanghai. Through a connection with the American cable, it is intended to eliminate British influence over the German and Dutch cable business with East Asia. A company for laying the cable is being formed, with a capital of $1,750,000, the German and Dutch Governments giving large subsidies. It is also intended to issue a 4 per cent. loan of $1,875,000, which will be taken by the Dresdner Bank, the Schaaffhausen Bank, the Disconto Gesellschaft, and the Darmstaedter Bank of Berlin, and two Dutch banks. This new announcement comes just after the completion of the second cable between this country

and Germany, and gives force to our remark as to the apparent indifference of cable people to wireless progress. We do not quite understand all this Teutonic activity in the submarine cable field, but possibly in dull times the cable manufacturers are willing to help push things a bit with the financiers so as to keep their factories employed. There are, of course, political and strategic reasons to be considered and at such a hint is pointed in the advices from Frankfort.

MOTOR DRIVE AND ROPE DRIVE.

Lest our motor friends should think that they are going to have it all their own way in factories under the régime of universal electric power, we venture to call their attention to a challenge which may perhaps jog their complacency and apathy this sultry weather. The cudgels have lately been taken up strongly for rope drive and discussions of the subject by the New England and Southern Cotton Manufacturers' Associations have led to the action to which we now call notice. The American Manufacturing Company, of New York City, manufacturers of transmission rope and other cordage, agrees to furnish the necessary rope sheaves, rope and driven head for the main drives of any cotton or woolen mill in the United States, using 500 or more horse-power, which is developed at the mill site, at one-quarter the price for which any responsible company furnishing electrical apparatus will agree to install the generators, motors, motor shafts, switchboard, wiring and other appliances necessary to electrically transmit the same power. Where the power is generated at a distance, if the mill will install one central motor, the company will agree to distribute the power from the motor to the main line shafts with rope drives for one-half the cost of electrical apparatus to distribute the same power. We confess our utter inability to see how this proposition is going to prove that electric power is not all that is claimed for it, but we should be glad to see the bases upon which such an offer is taken up as economically sound and best—if it is accepted by anybody. Meantime, our motor friends will observe that they still have a good deal of missionary work to do.

OIL FOR INSULATING PURPOSES.

Among the papers read at the recent convention of the National Electric Light Association was one by Mr. C. E. Skinner, entitled as above, which contains an excellent résume of the principal data relating to transformer oil and switch oil. With steam turbines busily engaged in reducing the opportunities for the use of mineral oil, there is comfort for the central station engineer in the reflection that many hundreds of thousands of gallons of oil are being used annually for the insulation of transformers and similar apparatus. If the adoption of electric lighting sets a limit to the classical cry for oil because our lamps have burned out. at least it sets up partial restitution by the modern cry for oil because our transformers have burned out. We must have oil to insulate with, even though we do not have oil to burn. The paper points out two very significant facts in connection with mineral transformer oil, namely, that one-thirtieth of one per cent. of water in the oil markedly reduces the dielectric resistivity, and, moreover, that after one-fifteenth of one per cent. of water is present, the further reasonable increase in the quantity of water does not reduce the dielectric resistivity much further. Thus, according to certain tests cited, a sample of dry oil showed that 9.5 kilovolts were required to disrupt a gap of 75 mils, or 1.9 mm., between brass balls ½ inch, or 1¼ cm., in diameter. The effect of 1/50th of 1 per cent. of water mingled with the oil appears to have brought the disruptive voltage for this gap down to 5 kilovolts, or nearly one-half. On the other hand, about ¼ of 1 per cent. of water only reduced the voltage to 3.6 kilovolts. The moral of this tale is "keep your oil dry", like the old watchword of the flint-lock age, "keep your powder dry."

Fortunately, the heat liberated within transformers when in use promotes evaporation of moisture, and thus tends to maintain high dielectric resistivity. It would seem likely for the same reason that high-tension transformers would be more apt to break down, tensionally, after some weeks or months disuse, when moisture had somehow succeeded in condensing into the oil. The paper also shows how misconceived and erroneous are the ordinary notions concerning the inflammability of oil. The popular idea is that oil is highly inflammable, derived from observations of conditions in which oil is spread out into thin layers, readily capable of being heated to the burning point. In bulk, it is shown that oil is almost like water in its non-inflammability. The author of the paper describes experiments that demonstrate this property, and alludes to a recent case in which a blazing transformer was dropped into an oil tank to put out the fire. This is a case of adding fuel to a flame, too suddenly for the existence of the flame. The paper is both valuable and timely. It would seem that the main dependence of the electrical engineer for insulation in dealing with high tensions must be, among fluids, upon oil and air. Of these oil is incomparably the superior, and air by far the more plentiful. In the buildings, oil is being used. In the transmission lines air is relied upon. The better we can depend upon oil within doors, the better we can face the problems of air out of doors.

EFFICIENCY CURVES OF CONVERTERS.

Prof. A. S. McAllister, in his article printed last week, pointed out that in the ordinary converter the loss of power at any load may be fairly well represented as the sum of a constant or friction term and a variable which is proportional to the square of the load current. On the assumption that this statement of the losses is strictly correct, the efficiency curve with respect to load would be a hyperbola, the maximum point of which would mark the equality between the two terms referred to; i. e., equal constant and variable losses. This result is pointed out as being a close approximation. Nearly all dynamo-electric apparatus is subject to the general rule of having a substantially constant loss, and also a loss increasing with the square of the current. In so far as the proposition is correct, it has been shown that the efficiency curve is an acute hyperbola, with its maximum at equal constant and varying losses, and with the percentage drop in the apparatus equal to half the drop in efficiency below 100 per cent. Even when, owing to secondary effects of loading, the frictional losses do not remain constant, the departure from constancy is rarely so great that advantage cannot be gained in practice from the application of these propositions to the efficiency curve of a machine. For example, if the efficiency curve is still rising at full load, then either the frictional losses may be regarded as unduly heavy, or the I^2R losses are not up to their ordinary magnitude. As a rule, designers aim at making the efficiency a maximum at the average load of operation, and this is often in the neighborhood of three-quarters load.

EXPERIMENTS WITH THE MAGNETIC DETECTOR.

Our esteemed contemporary, *The Physical Review*, is always welcome, and is given an honored place on the shelves we devote to more erudite, but less immediately utilitarian, scientific literature. It is now more welcome than ever, since it has within the last two months adopted the sensible practice of issuing its pages cut. Physics is long and life is short, and no man should be compelled to do badly and laboriously by hand that which a machine can do well and easily by power. To issue a periodical, with pages uncut, is to tempt Providence and the winsome reader not to read. Although the paper knife is bloodless, yet its use excites more profanity than the sword. On page 1120 of our issue this week is an abstract of an article on

some experiments by Prof. Arthur J Foley, published in the May number of *The Physical Review*, on the magnetic wave detector. The theory of action of this wave detector is that the Ewing hysteretic diagram is not shaped like a parallelogram, but something like the *f*-hole of a fiddle. The permeability of iron or steel undergoing cyclic magnetization may be defined by the expression, $\frac{d\mathfrak{B}}{d\mathfrak{H}}$ or as the gradient of magnetic flux density, when plotted with respect to magnetic force. When the curve is steep a very small change in magnetic force is accompanied by a large change in flux density; whereas, when the curve flattens, the same small change in magnetic force is accompanied by but a small change in flux density.

If now a primary and secondary winding are associated on an iron core, *small* electric reversals in the primary circuit will set up electric reversals in the secondary circuit, the magnitude of which depends, among other things, upon the permeability of the iron core; for the magnitude of the secondary impulses depends upon the extent of the change of magnetic flux linked therewith, and the greater the permeability of the iron core, the greater will be the flux changes, for a given range of magnetic variation produced by the electric reversals in the primary winding. Consequently, the permeability curve has to be as steep as possible. The Ewing diagram shows that in feeble cyclic magnetizations, the curve of $\mathfrak{B}$ becomes very steep in ascending and descending, near the mean vertical through the center of the diagram. This is the best condition of the iron core for sensitiveness in the transformer. The permeability in this steep and sensitive part of the *f* may be twenty times greater than the average permeability of the iron taken throughout the cycle. Steps must be taken, however, to renew the magnetic youth of the core, at regular intervals, by cyclic demagnetization. The function of the permanent horseshoe magnet is to bring the iron core to the brink of the sudden declivity, and then allow the feeble received electric impulse to push it over the precipice. For this reason the sensitiveness of the transformer rapidly dwindles as the magnetization becomes effected in each reversal. The sensitiveness, on the other hand, is great just when the last polarity is being wiped out and when the iron is nearly passive. Then a little disturbance in the primary coil, with a small resulting variation in $\mathfrak{H}$ will make a relatively large oscillation in $\mathfrak{B}$. All of the observations described in the article appear to be consistent with the above hypothesis.

AUXILIARY BUSINESS FOR CENTRAL STATIONS.

Two of the papers at the recent convention dealt with the much-mooted subject of "side lines" of business for central stations. One of them was an analysis of the results obtained from district heating, the other a suggestion of a new field of endeavor in the manufacture of artificial ice. Last year one of the convention papers dealt with salt works as an auxiliary source of revenue, and there is a steady tendency to study more and more these outlying fields of activity. Broadly, the situation is this: Every central station suffers from inability to utilize fully its investment in the production of its ordinary output, and besides there is in the operation of engines a thermal loss which is present at all loads. The task of dealing with these two conditions is not an easy one, and the conditions themselves are essentially distinct. The heat loss in exhaust steam and in condenser water is one which is greatest at full load, and save in stations with a large load factor, is very difficult to utilize to advantage. The loss by idle investment and by running at uneconomical load falls most heavily on stations with poor load factors, and can be avoided only by forms of utilization which in time do not coincide with the peak. Obviously, if the heat rejected by the engines could be utilized to carry on work which at times of low load could be handled directly from the unused capacity of the plant, the theoretical result would be good; but in practice the very different temperatures of the rejected and the deliberately produced heats hinder their use for a common purpose.

As regards the use of exhaust steam for heating, there is no doubt whatever that its sale is an additional source of revenue which is at times important, but as we have many times remarked, the presence of exhaust steam in an electric plant is in the vast majority of cases irrefutable evidence that electrical energy is being produced uneconomically. Unquestionably, part of the loss may be stopped by selling the steam which ought to have been better utilized in the engines, but we do not believe that it is generally and broadly an economic policy. Under exceptional circumstances, exhaust steam at extremely light pressure or even condenser water can be utilized locally for heating with admirable results. In other cases the local conditions are such that a central heating plant in itself would pay a fair return upon the investment required, and under these circumstances an electric plant can utilize its spare boiler capacity to some advantage, though as a rule the boilers fitted for use with modern high-pressure engines do not work to the best advantage for heating alone. Each plant must work out its own salvation in its own place and way as regards these heating problems. The one common error to be avoided is the supposition that exhaust steam costs nothing to speak of, and that a little back pressure is of no account. If the manager of a station with first-class condensing engines will cut out the condensers, choke the exhaust and then do a little work with the indicator after inviting in a few non-condensing friends, he will do a good bit of missionary work. Where the fuel and other costs are such that there is but little saving in condensation, exhaust steam may be worth more for heating than for power.

To our mind the auxiliary business which utilizes the spare capacity of a plant without injury to the efficiency of power production is far more interesting and satisfactory. The practical problem is as follows: A given plant being unable to build up its load factor beyond a certain point, to what uses can it apply its spare capacity taken at the times and in the amounts in which it becomes available? Clearly, the use must be discontinuous or at least not essentially steady in its demands for power, as otherwise there will be trouble at the peak. And also the business thus taken up should require power if possible all the year round with a maximum in summer. The ice plant as suggested in Mr. Wakefield's paper meets these conditions rather well. In the warmer parts of the country there is a fair demand all the year round, but most in summer when the lighting load is small. Also, if the process be properly worked, the call for power may be very greatly reduced over the peak of the load or even temporarily suspended. Search should be made for other lines of business which can be worked during hours of light electrical load without too serious investment. Any simple business in which there is a large demand for power can be profitably utilized if it can be kept clear of the peak of the load. It is even conceivable that a station able to furnish power cheaply might operate a manufacturing process with a working day deliberately arranged to begin abnormally early and to close before the peak. In fact, in Montreal this latter condition has been realized during the winter months in connection with electric power supply to factories. Certainly, it could often afford to give unusual inducements to a customer who would agree thus to arrange his hours of operation. Water power plants whose cost of operation varies very little with the load could build up their load curves in this way to great advantage, and might get material aid from industries which, like certain electrochemical ones, must get power cheaply and use it in large amounts.

A. I. E. E. High Tension Transmission Meeting.

As previously noted in these columns, a special meeting of the American Institute of Electrical Engineers will be held at Chicago June 21 and 22, the proceedings of which will be confined to a consideration of subjects relating to high-tension electric transmission. The meeting will be conducted by the Transmission Committee, of which Mr. Ralph D. Mershon is chairman, assisted by the Chicago branch of the Institute. There will be a morning and afternoon session each day. Six papers, or introductions to discussions, are on the programme, which will be considered during three of the four sessions. At the fourth session the Committee on Transmission Data will report, and there will be a general discussion on the topics presented at the meeting. The papers are printed in the May issue of the *Transactions* of the Institute, and it is requested that contributions for the discussion of the same be mailed to Mr. Ralph D. Mershon, 29 Broadway, New York, so that they may be received not later than June 17, 1904.

Mr. W. G. Carlton will contribute a paper entitled "Protection of Cables from Arcs Due to the Failure of Adjacent Cables." The paper refers particularly to the protection of cables operated at from 5,000 to 15,000 volts, these nearly always being three-conductor cables. One method of protection noted is to wrap the cables with asbestos paper or tape about one inch thick, using two layers and binding on the asbestos by means of steel or brass tape, which is applied either in an open spiral, leaving an inch or more between the turns, or with edges touching, leaving no open space. While this protection has been found adequate by several large companies, its life is uncertain on underground work and a disadvantage is that heat is less easily radiated on account of the asbestos covering. Another method of protecting cables consists in providing separate chases or runaways for them, and a third method consists in the use of a covering of vitrified clay tile. All of these methods apply more particularly to protection of cables outside of ducts. The experience of one company in Chicago has been that nearly all the trouble on high-pressure cables has been due to defective joints, moisture in the cables near the joints or to sharp bends in the cable. Some burn-outs have occurred due to the lead sheathing of the cables being damaged by electrolysis, but trouble from this source can be prevented by grounding the sheathing at intervals.

Mr. B. G. Lamme contributed a paper entitled "The Synchronous Motor for Regulation of Power Factor and Line Pressure." The conclusions of the paper are as follows:

1. A synchronous motor can be used to establish leading or lagging currents in its supply system by suitable field adjustment, and can thus affect or control power factor or phase relations of the current in the alternating-current system. 2. A synchronous motor will set up leading or lagging currents in its supply system if its field strength is held constant, and the pressure of the supply system is varied above or below that generated by the synchronous motor. Such leading or lagging currents in the supply system will tend to vary the pressure of the system. A synchronous motor can thus act as a regulator of the pressure of its supply system. 3. This regulating action is greatest with synchronous motors, which have the closest true inherent regulation (as indicated by high field magnetomotive force compared with the armature magnetomotive force) in distinction from machines which have close apparent regulation obtained by saturation of the magnetic circuit. 4. If the synchronous motor is used both for regulating the power factor for neutralizing the effect of other apparatus on the circuit, and for regulating or steadying the pressure of the supply system, its normal capacity for regulating will be diminished. 5. The most suitable speeds for best electrical conditions will in general be considerably below highest possible speeds as limited by mechanical conditions. 6. Heavy dampers will increase the effectiveness of the regulating tendency. 7. If the synchronous motor can be used for power purposes as well as for regulation, its apparent capacity is increased. This is due to the fact that the regulation is obtained by means of a wattless component and the power from the energy component, and the algebraic sum of these two is greater than their resultant which fixes the current capacity of the machine. 8. Synchronous converters in general are not suited for regulating the pressure or controlling the power factor for an alternating-current system. 9. The cost of synchronous motors for regulating purposes will, in general, be lower than for alternating-current motors or generators of customary speeds, and will approach more nearly to turbo-generator practice.

In a paper entitled "Long Spans for Transmission Lines," Mr. F. O. Blackwell considers the subject under the heads of cost of towers, strength of conductor, elasticity, strain in conductors, sag of wire, height of towers, insulators and pins, cross arms and construction of towers. The paper includes span and sag curves for aluminum and copper wire.

Mr. M. H. Gerry, Jr., in a paper, will discuss the conditions of continuous service over lines operated in parallel, under the heads of normal operating conditions and accidental conditions. Since little work can be done on high-pressure circuits, while in service, this implies that adequate switching devices must be provided, and the paper considers in detail the matter of such devices.

In a paper entitled "The Use of Ground Shields in Transformers," Mr. J. S. Peck criticises the use of such shields. His conclusions are that since the ground shield does not offer absolute protection, while it increases the cost and reduces the efficiency of the transformer and introduces mechanical and electrical difficulties, its use for high-pressure transformers is a theoretical rather than a practical means of protection. He considers that the grounding of the low-pressure winding at the neutral is a safer, more practical and cheaper method of protection than is the use of the ground shield.

Mr. H. C. Wirt will have for the subject of a paper, "The Protection of High-Pressure Transmission Lines from Static Discharges," which will be considered under the heads of ground wires and reactive coils. Mr. Wirt expresses the opinion that a transmission line can be protected from lightning discharges by suitable apparatus placed in the stations, and that it is not necessary to use ground wires, though possibly an exception should be made in cases where poles are shattered with great frequency. As to the use of reactance coils, he considers there can be no question that such coils are effective and, therefore, should always be used.

A Government Wireless Mix-up.

According to the New York *Evening Post*, the proposed government operation of coast line wireless stations has led to considerable friction between the Navy, Army, Treasury and Agricultural Departments, with the Department of Commerce and Labor yet to be heard from, and Congress, at its next session, will be called upon to deal with the imbroglio.

According to the *Post* correspondent, the Navy Department desires to abolish all shore line stations in competition with the Slaby-Arco system, and to make that exclusive within zones of 240 miles, though it is stated that this system has proved effective only over a radius of 70 miles. Meanwhile, the ocean-going steamers have installed the Marconi instruments, and that company refuses to exchange with the Slaby-Arco system, or any modification of it.

Gen. Greely regards the navy scheme as impracticable, and says that while all but one company may be driven from the coasts of the United States, continental and insular, so long as steamship companies prefer and employ another system, there is no redress, and the adoption of one scheme to the exclusion of all others is a detriment to the country, unless by means of it ships may be reached. Moreover, beyond a three-mile limit lie the high seas, where no one country can hope successfully to control.

The several departments are using various wireless systems, each under bonds protecting the United States from possible complications from patent infringements. The army is experimenting with a combination of the De Forest and the Signal Corps, or Wildman system, having purchased apparatus in the open market whenever it was considered by the Signal Corps reasonable in price. The extreme test of its efficiency is to be made in Alaska, where it is hoped to cover 107 miles. This is across a bay where ice for three successive winters has swept away the cable. The department has been driven to use a wireless system or go without communication. The army claims that its system is the best for practical purposes, and that having experimented in this line long before the navy began, it ought to have the weight of authority.

In the customs collection district of Puget Sound the Treasury Department is employing what is termed by both the army and navy experts a nondescript service, which these experts say is of use for a distance of only twelve miles. The Agricultural Department is in a tangle with Fessenden and claims to own the system which bears his name, because he developed it while he was employed by the department.

Hudson River Power in the General Electric Works.

TRANSMITTED water power from Spier Falls on the Hudson River is used in the General Electric Works more than 30 miles away. Electric power from the Hudson has operated parts of the machinery at Schenectady since 1898, the first supply having been from the water power plant at Mechanicville, some 15 miles distant. Within the past year, however, the great station at Spier Falls has been started, new transmission lines have been strung and now both of these water powers are delivering energy for use in the greatest electric manufacturing plant in the world. As the generating equipment at the Spier Falls plant is still incomplete, the maximum amount of power covered by the contract between the Hudson River Water Power Company and the General Electric Company is not yet delivered at the works of the latter company. This contract is said to call for a maximum delivery of 10,000 hp under certain conditions, and the General Electric Works have already received as much as 6,000 kw.

Between Spier Falls and the General Electric Works there are two three-phase, 40-cycle, 30,000-volt circuits. Both of these circuits are composed of medium hard bare copper wires, the size of wire in one circuit being 1/0 and in the other circuit 3/000 B. & S. gauge. At Alplaus switch house through which these lines pass at a point about five miles north of the General Electric Works, they are joined by a three-phase circuit of No. 3/0 wire from the Mechanicville water power station. By connections at this switch house energy from Spier Falls may pass to the General Electric Works over one of the two circuits, and energy from Mechanicville over the other, or both circuits may transmit the Spier Falls power.

After crossing the Mohawk River and the Erie Canal the two circuits of bare wires from Alplaus switch house enter a terminal house of special design that stands between the Erie Canal and a branch of the New York Central & Hudson River Railroad, on land of the General Electric Company. From this terminal house the two 30,000-volt circuits cross River Road, Schenectady, by means of six insulated cables, and enter the tower on a transformer house that stands in the yard of the electric works. In this house are located transformers that lower the pressure of the transmitted energy to 10,000 volts, and from these transformers the secondary circuits pass at once to the switchboard in what is known as power station No. 13, which is nearby.

At this switchboard the 10,000-volt current is distributed through transformers to four rotary converters, to a motor-generator, to a shop-testing circuit, and through several cables to the new Dock Street sub-station of the Schenectady Railway Company. From this sub-station both the railway system of this company extending to Albany and Troy, and also the local system of light and power in Schenectady are supplied with current, as described in the ELECTRICAL WORLD AND ENGINEER of May 14, 1904. The lines to the sub-stations at Colone and Latham's Corner on the Schenectady railway system formerly ran back to the switchboard at the General Electric Works, but these lines now enter the Dock Street sub-station.

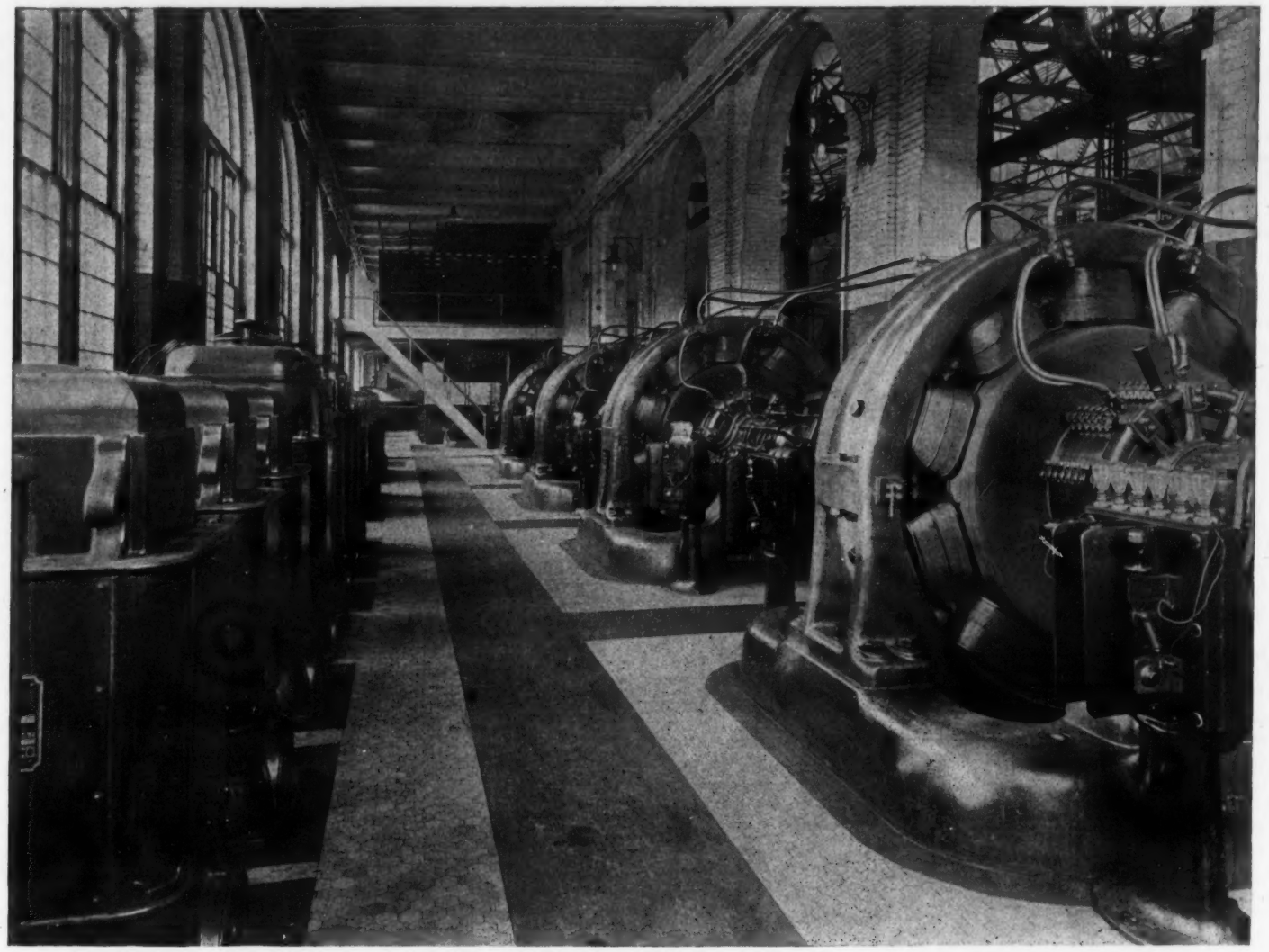


FIG. 1.—POWER STATION AT GENERAL ELECTRIC WORKS, WHERE CURRENT FROM SPIER FALLS IS CONVERTED.

The terminal house of the Hudson River Water Power Company on the General Electric property, where the bare 30,000-volt circuits from Spier Falls and Mechanicville enter, is a two-story building with brick outside walls resting on a concrete foundation. A layer of concrete 6 in. thick forms the ground floor of this house, its second floor is concrete supported by steel beams, and the roof is composed of 2¼-in. hemlock planks covered with tar and gravel. In outside dimensions at its first floor level the building measures 6 by 30 ft., and the center of the roof is 23 ft. 6 in. above the ground floor. From the ground floor to the ceiling of the second floor the distance is 10 ft. For the height of the first story the outside brick walls are 12 in. thick, and for the second story their thickness is 8 in. An 8-in. brick wall running parallel with the longer sides of the terminal

house divides its first story into two parts, one of which is 5 ft., and the other 4 ft. 4 in. wide. At each end of the house there is a door to each of the apartments thus formed.

The second floor of the house forms a single room and this is entered by a door at each end that opens onto an iron platform,

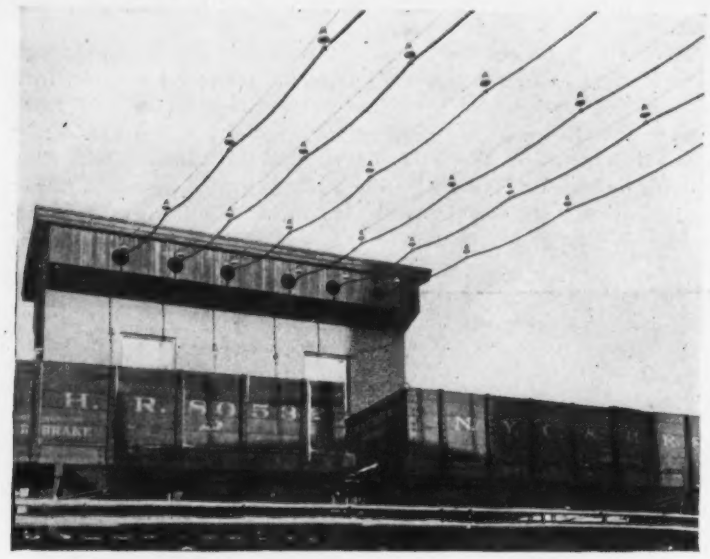


FIG. 2.—30,000-VOLT LINES OVER RIVER ROAD AT GENERAL ELECTRIC WORKS.

from which an iron ladder leads to the ground. Besides small windows in the doors, each floor is lighted through two windows in the River Road side. The upper story of this terminal house contains

In the apartment on one side of the first floor there are the lightning arrester cells, and in the apartment on the other side there are instrument transformers and recording wattmeters. Along each of its longer sides the roof extends beyond the wall of the terminal house, and from the roof a weather shield made of boards drops down and turns in toward the wall, so that its lower edge is distant 3 in. from the wall and 19 ft. 1½ in. from the level of the ground floor. In the long side of each wooden wind shield there are six circular openings of 15 in. diameter each, and the brick wall next to each wind shield contains six circular openings of the same diameter and directly in line with the corresponding holes in the shield. The centers of all of these circular openings are 19 ft. 10½ in. above the level of the first floor.

On the canal side of the terminal house the six bare wires of the two, three-phase circuits from Spier Falls enter through the six circular openings on that side to the second story. On the River Road side of the house the six insulated cables representing these circuits leave through the six openings there, and cross the road to the tower of the transformer building. Directly in front of each 15-in. circular opening in the brick walls of the terminal house, and with its axis distant about 10½ in. from the inside surface of the wall there is a porcelain insulator mounted on an iron rod that passes entirely through it. The length of this insulator is about 14 in., and the diameter of each of its four petticoats is 9 in. At a point midway of the length of each insulator and with two petticoats above, and two below, the conductor is secured that passes through the adjacent opening.

Each of the six conductors that enter the terminal house from Spier Falls passes directly to a three-point, double-blade knife switch after leaving the insulator just mentioned. One blade of this knife switch connects the incoming conductor with a bank of lightning arresters in the first story, and the other blade of this switch connects with one pole of an oil switch on the second floor. The circuit

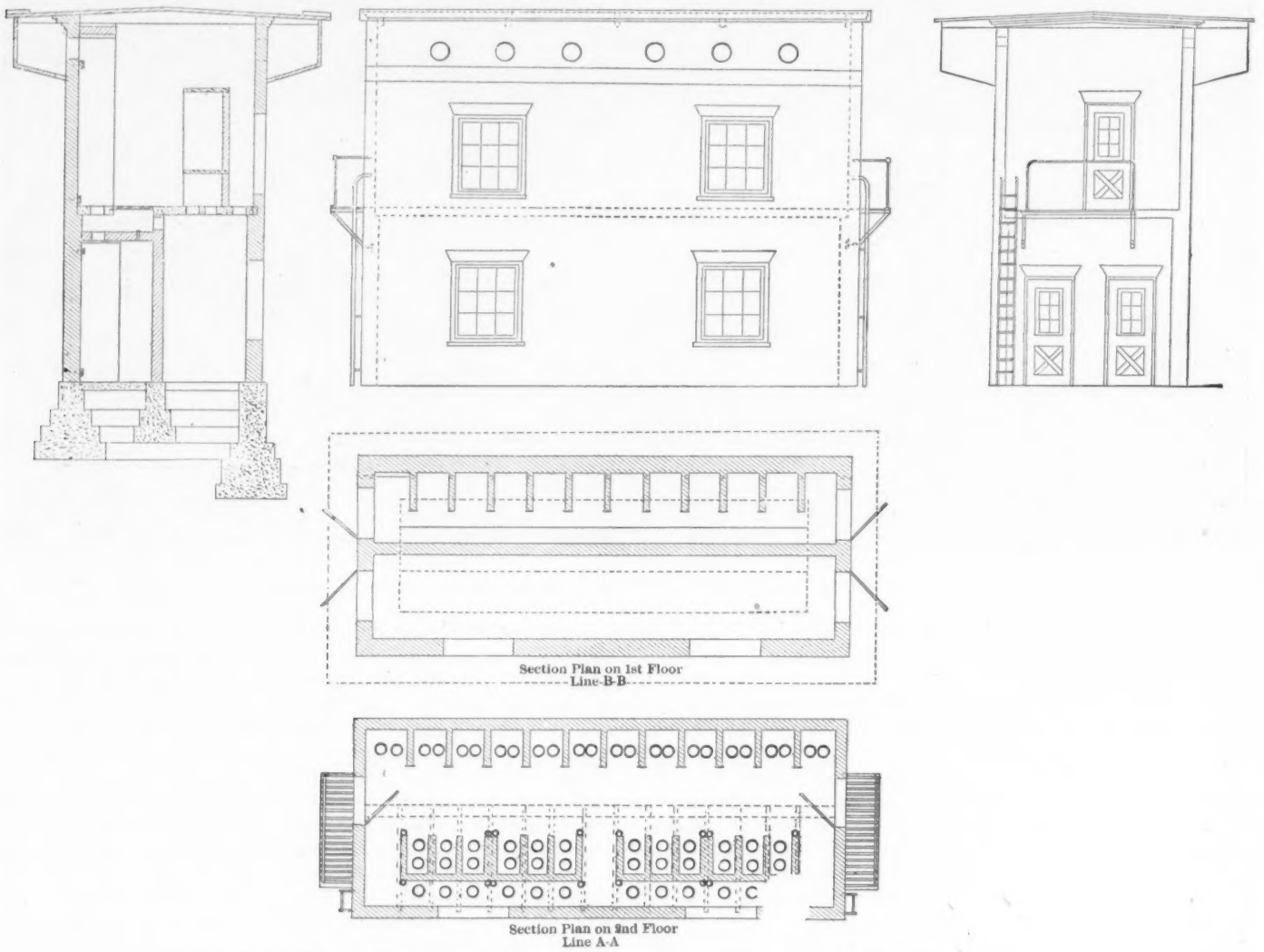


FIG. 3.—ELEVATIONS AND PLANS OF TERMINAL HOUSE AT SCHENECTADY.

knife switches on one side, and oil switches on the other side for the circuits that enter it.

of the conductor just mentioned, after passing through the oil switch, enters a single-blade knife switch where a tap is taken from an in-

strument transformer, and then rises to an insulator in front of one of the circular openings on the side of the terminal house next to the River Road. Near the insulator last mentioned a rubber-covered cable is connected to the conductor in question, and this cable passes out through the 15-in. opening and across the River Road to the tower on the transformer house. Each of the six insulated cables is supported across this road by a steel cable with underhung insulators.

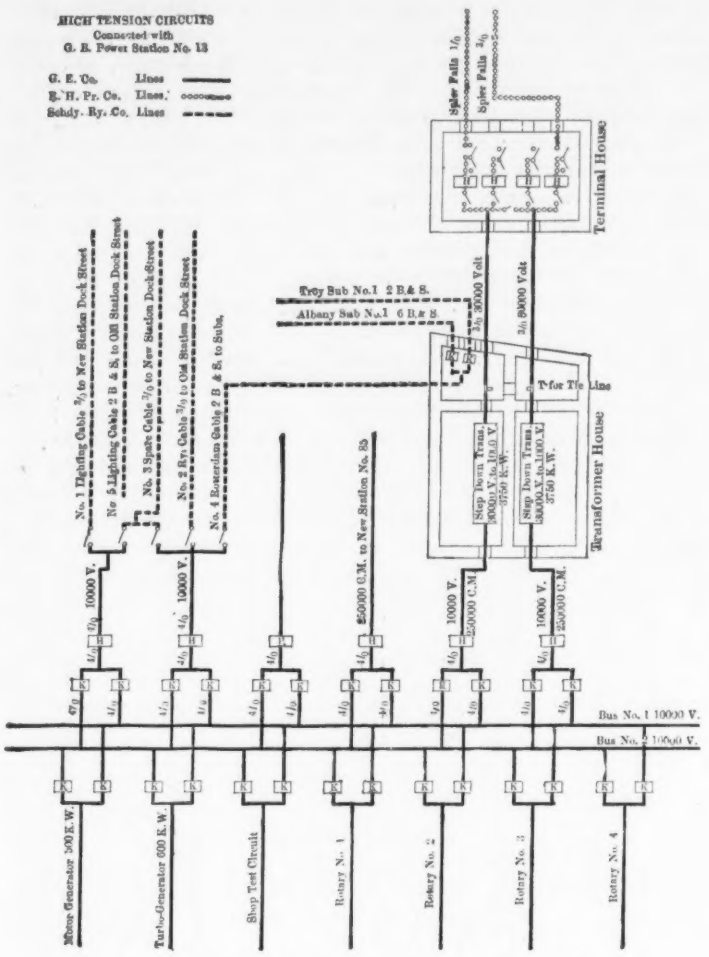

HIGH TENSION CIRCUITS
Connected with
G. E. Power Station No. 13
G. E. Co. Lines
E. H. Pr. Co. Lines
Schdy. Ry. Co. Lines
Spier Falls
Terminal House
Troy Sub No. 1 2 B. & S.
Albany Sub No. 1 6 B. & S.
T for Tie Line
Step Down Trans.
Transformer House
No. 1 Lighting Cable to New Station Dock Street
No. 5 Lighting Cable to New Station Dock Street
No. 3 Spare Cable to Old Station Dock Street
No. 2 Rys. Cable to Old Station Dock Street
No. 4 Rotaries Cable to Subs.
10000 V.
250000 C.M. to New Station No. 83
Bus No. 1 10000 V.
Bus No. 2 10000 V.
Motor Generator 500 K.W.
Turbo-Generator 600 K.W.
Shop Test Circuit
Rotary No. 1
Rotary No. 2
Rotary No. 3
Rotary No. 4

FIG. 4.—DIAGRAM OF HIGH-TENSION CIRCUITS.

in. deep from back to front, and 24¾ in. wide, except as to the end cells. The walls between these cells and also their roofs are 4 in. thick. Each of these cells is intended to contain one of the double-blade knife switches already mentioned, but at present only six of the cells are occupied because only two three-phase circuits now enter the terminal house from Spier Falls. The terminals of each double-blade lever switch are mounted in large iron caps carried on porcelain insulators, and these insulators are supported by large wooden pins that enter a wooden frame in each cell.

On the first floor of the terminal house and directly beneath the twelve cells just described on the second floor, there are twelve other cells like those above. These cells on the first floor are intended to receive the banks of lightning arresters for the several conductors of the entering transmission circuits, and six of the cells are now so occupied. In each of these six cells there is a wooden frame on which are mounted 42 of the brass cylinder type of lightning arresters. Each arrester carries five small brass cylinders on a porcelain base, and between the sides of these cylinders there are four air-gaps each about 1/32 in. in length. The group of 42 arresters joined in series connects one conductor of a circuit with the ground, so that any discharge over the arresters must jump 168 of the 1/32-in. air-gaps.

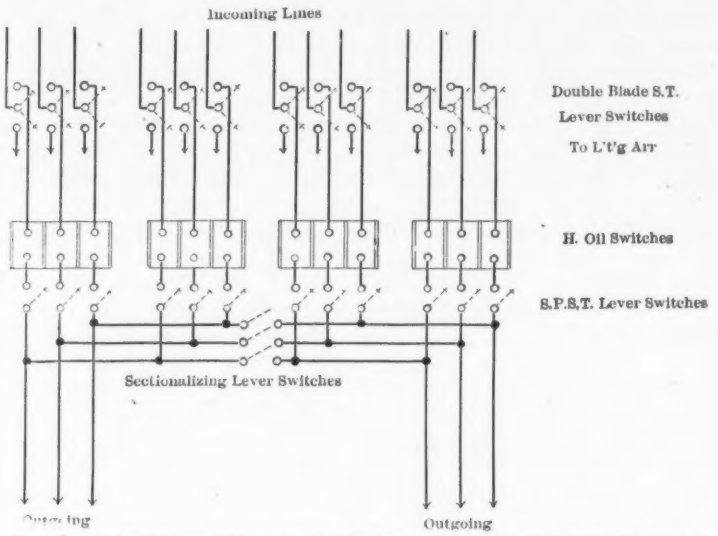


FIG. 6.—DIAGRAM OF MAIN CONNECTIONS, SCHENECTADY SWITCH HOUSE.

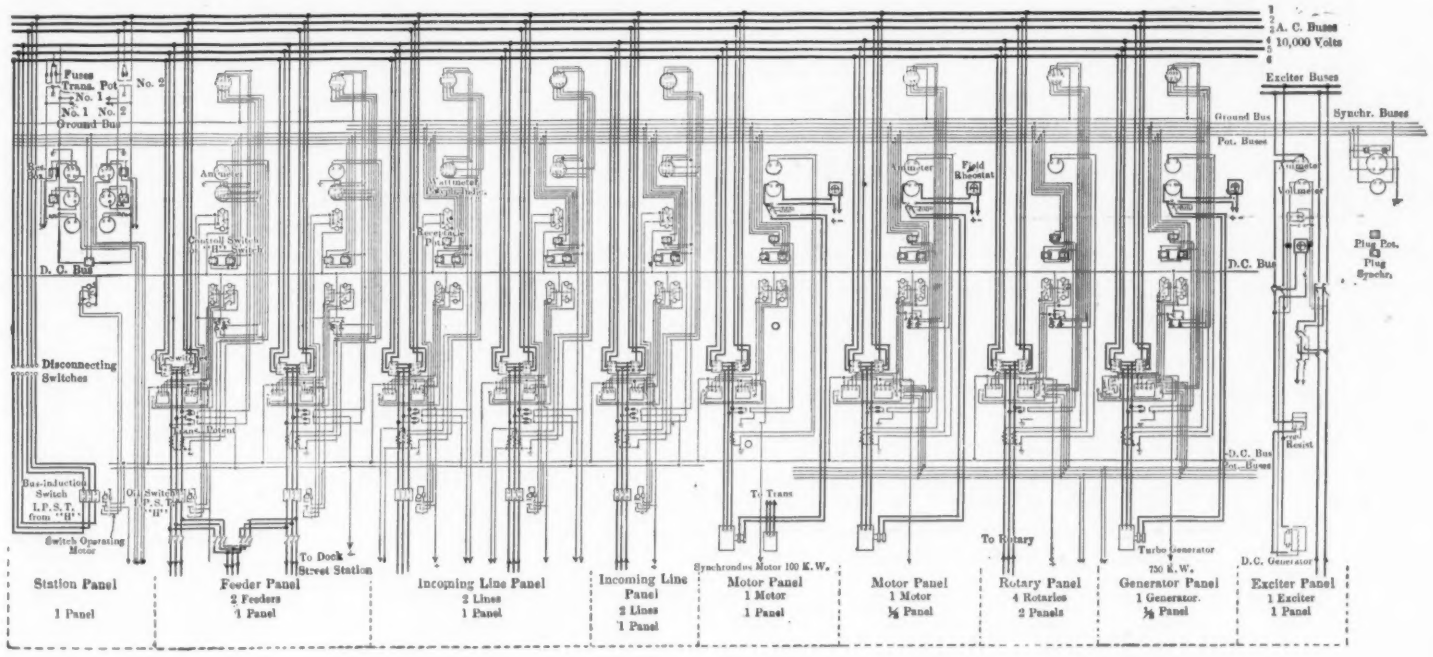


FIG. 5.—DIAGRAM OF SWITCHBOARD WIRING.

Each of the twelve circular holes, that pierce the outer brick wall of the terminal house for the circuits from Spier Falls to enter, opens into a brick cell on the second floor that is 10 ft. 9 in. high, 27

Opposite the lever switch cells, and near the River Road side of the terminal house there are two groups of cells for "H" oil switches of General Electric make. Each group consists of six cells and provides for two three-pole switches of the type just named. The six cells for two switches occupy a space 10 ft. 9 in. long, 2 ft. 9 in. wide

and 7 ft. 4¾ in. high above the floor. The back and end walls of these cells are of brick 4 in. thick; the side walls between different poles of the same switch are also 4 in. thick, and the soapstone tops and inside shelves have a thickness of 2 in. each. From front to back each cell is 29 in. deep, its width is 16 or 17 in., and its height from interior shelf to top is 5 ft. ¾ in. The three adjacent cells at each end of each group are designed to contain the three sets of double-break contact parts that go to make up a triple-pole, 200-amp., 30,000-volt oil switch, form H, there being one pole in each cell. On the soapstone tops of the cells there is mounted the electrically-operated mechanism of the switches.

As only two circuits now enter the terminal house from Spier Falls, only two of these 200-amp., 30,000-volt switches have been installed. When the two other circuits from water power plants for which provision has been made enter the terminal house and connect with switches like those just named, two of the four entering circuits will connect through lever switches with each of the two circuits that pass from the terminal house to the tower of the transformer house. At the present time each of the two circuits from Spier Falls connects through its oil and lever switches with one of the two circuits that go to the transformer house, but these last-named circuits may be put into multiple by means of lever switches. These electrically-operated, 200-amp., 30,000-volt oil switches in the terminal house are controlled at the switchboard in power station No. 13 of the General Electric Company.

The six conductors of the two three-phase circuits from the terminal house enter the tower of the transformer house through six circular openings in the brick wall, each of which is 15 in. in diameter, and the three openings for each circuit are spaced with their centers 4 ft. apart. An interior brick wall divides this tower into two compartments, and the wires of each circuit enter one compartment. Within these compartments each conductor of the two circuits has a T for a tie line connection, and openings through the wall that separates the two compartments permit three jumpers or tie lines to pass between the two circuits and thus put them in multiple, when desired. From its tower compartment each circuit passes into a separate transformer room, and the two tower and two transformer rooms take up the entire transformer building.

This building was not especially constructed for its present purpose, but it has been remodeled to fit it for a transformer house. Except as to its tower at one end this building is one story in height, and its four sides have lengths of 29 ft. 5 in., 48 ft. 11 in., 30 ft. and 42 ft. 11 in. on the outside, respectively. The external walls of this transformer house are of brick, and are 12 to 16 in. thick; a 12-in. internal brick wall separates the tower from the one-story part, and a 16-in. wall divides the one-story portion into two nearly equal rooms. In both rooms there are wooden floors laid over 6-in. beds of concrete, and the roof is laid with slag on 1¾-in. plank. In that part of the roof over each room there are two 30-in. circular ventilators of sheet iron.

Beneath each of the two transformer rooms there is a compressed-air pit 33 ft. long, 7 ft. deep, 3 ft. 4 in. wide in the one case and 4 ft. 2 in. wide in the other. Three transformers and a motor-driven blower are located over one of these pits, and four transformers and a like blower over the other pit. Three of these transformers are regularly connected to one of the transmission circuits and three others to the other circuit, and the seventh transformer is a spare. Each of these air-blast transformers is rated at 1,200 kw, 40 cycles and 15,030 to 9,700 volts. The three-phase transmission circuits that leave the step-up transformers at Spier Falls with a voltage of 30,000 have about 26,500 volts between each two conductors in the transformer house just described. Each group of the 1,200-kw transformers have their three primary coils connected to one of the 26,500-volt circuits in the Y form, and three secondary coils are connected in the Δ form, so that the transformation is from 26,500 to 9,700 volts, or thereabouts. The nominal rating of these six main step-down transformers is thus 7,200 kw, and on them depends the supply of transmitted water power for a large amount of machinery at the General Electric Works, the entire load of lamps and stationary motors on the electrical supply system at Schenectady, and the railway lines of that city with the branches to Albany and Troy.

From the secondary coils of each of the two banks of transformers just considered, an underground cable carrying three conductors of 250,000 cm. cross-section each passes to a 10,000-volt, 500-amp., three-pole, oil switch in power station No. 13. Two circuits connect this H switch with two sets of 10,000-volt, three-phase bus-bars, each circuit passing through a 10,000-volt, 300-amp., three-pole, K oil switch on the way. By the arrangement of switches in the terminal house either transmission line from Spier Falls may be connected to either set of the 10,000-volt bus-bars in the power station through either bank of transformers in the transformer house, or both transmission lines and both banks of transformers may be joined in multiple. These two sets of 10,000-volt, three-phase bus-bars distribute current to a shop-testing circuit, to the Dock Street sub-station, and to a motor-generator and from rotary converters in the old power station. The shop-testing circuit is supplied through a 250-kw, 40-cycle transformer that reduces the pressure from 10,000 to 120 volts. This transformer may be connected to either set of bus-bars through one of two K oil switches. Current to the motor-generator goes from either set of bus-bars through a K oil switch. The motor of this generating set is rated at 600 kw, 10,000 volts and 40 cycles, and is direct-connected to a 500-volt, direct-current generator of equal capacity, which operates at 480 r.p.m.

A bank of three transformers for each of the four rotary converters can be connected to either of the two sets of 10,000-volt bus-bars through one of two 300-amp. K oil switches that are provided for the purpose. Each of these four banks of transformers reduces the 10,000-volt alternating pressure so that each rotary converter delivers direct current of 250 volts at its commutators. The indi-

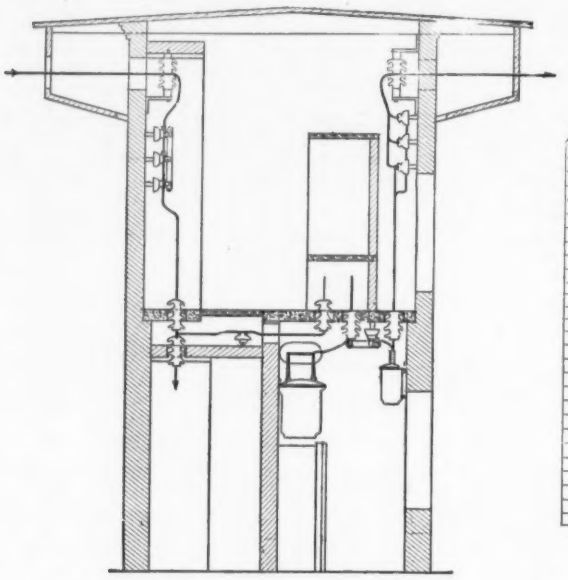


FIG. 7.—ELEVATION OF APPARATUS IN SCHENECTADY SWITCH HOUSE.

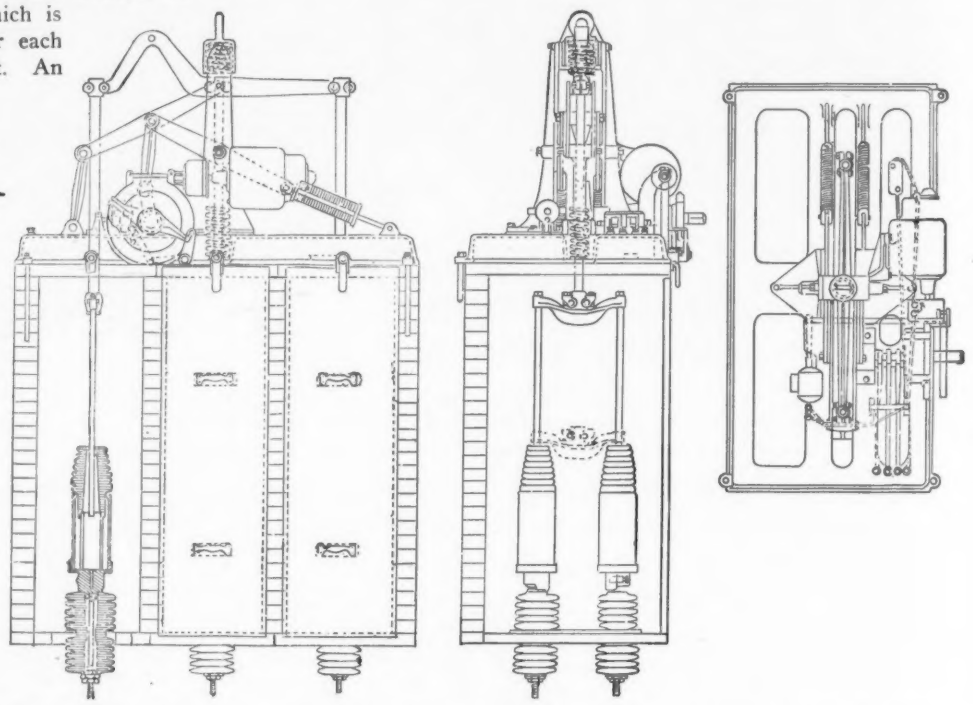


FIG. 8.—SECTIONS AND PLAN OF OIL SWITCH IN SCHENECTADY TERMINAL HOUSE.

vidual rating of these four rotary converters is 600 kw; they operate at 480 r.p.m., and the armature of each is double-wound and has two commutators. By connecting the two commutators of any converter in series, a voltage of 500 is obtained when desired. Current from these, from rotary converters and also from the 600-kw, 500-volt generator driven by the 10,000-volt motor is distributed to 250-volt and 500-volt motors in various parts of the General Electric works.

Two groups of switches are employed to connect the two sets of 10,000-volt bus-bars with underground cables that run to the Dock Street sub-station. Each of these groups consists of two three-pole, 300-amp. K oil switches that join respectively the two sets of bus-bars with a type H oil switch. Lever switches connect each H oil switch with one or two underground cables for the Dock Street sub-station. There are three of these cables each containing three 3-0 stranded copper conductors. One cable is devoted to the railway apparatus, and another to the lighting apparatus in the Dock Street sub-station, and each of these cables joins one of the type H oil switches at the power station through a lever switch. The third of these underground cables may be connected through either of two lever switches with the form H oil switch that carries the lighting cable, or the corresponding switch that carries the railway cable, as desired.

The cable from the power station that formerly ran to the Albany

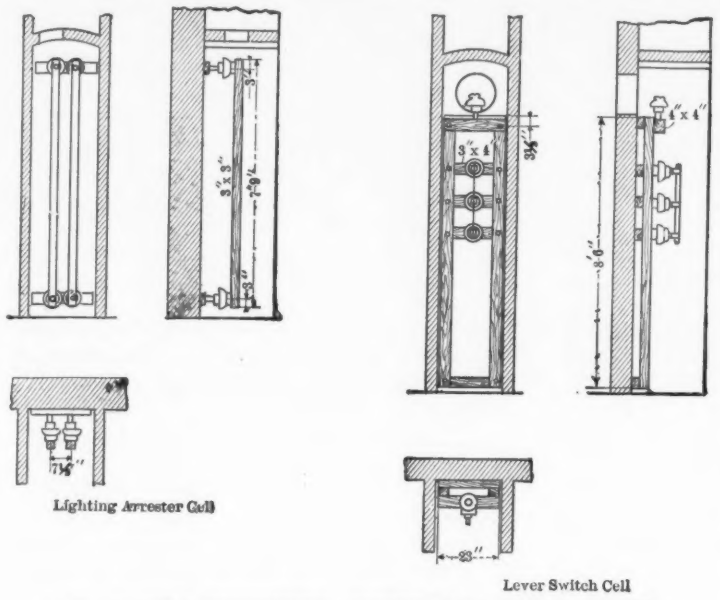


FIG. 9.—CELL EQUIPMENTS, SCHENECTADY SWITCH HOUSE.

and Troy sub-stations of the railway has been discontinued, and these sub-stations now take current from that at Dock Street. At the Dock Street sub-station the total capacity of rotary converters is 1,800 kw, of motor-generators 1,550 kw, and of both 3,350 kw. In No. 13 power station at the General Electric works the combined rating of the motor-generator, the four rotary converters and the transformer for the testing circuit amounts to 3,250 kw, so that the capacity of the apparatus connected to the transmission system at this station and at that on Dock Street is 6,600 kw, as a total. To this must be added the rotary converters at the Albany and Troy sub-stations of the Schenectady railway system.

Current for all the foregoing apparatus flows through the two sets of 10,000-volt, three-phase bus-bars in No. 13 power plant, and is normally delivered by the transmission lines from Spier Falls through the six transformers of 7,200-kw capacity that reduce the pressure from 26,500 to 9,700 volts. If the supply of energy from Spier Falls fails, the bus-bars just named may be connected to a single 600-kw, 10,000-volt, 40-cycle, three-phase turbine generator at the General Electric works, or either or all of four 1,500-kw, 10,000-volt, 40-cycle, three-phase turbine generators now located there in new power station No. 85. This power station is designed to contain six of these 1,500-kw turbines, and they will all take steam at 160 pounds pressure and operate at 800 r.p.m.

The facts as to this delivery of transmitted water power to the General Electric works, probably the largest delivery of its kind to a manufacturing plant anywhere in the world, have been secured through the kindness of Mr. A. L. Rohrer, of the General Electric Company.

New Engineering Building at the University of Colorado.

The University of Colorado, located at Boulder, thirty miles northeast of Denver, has recently completed a noteworthy addition to its engineering equipment in the form of an extension of the main building devoted to applied science. The old building has been supplied with new equipment, so that the whole structure now represents in every respect a thoroughly modern piece of educational machinery.

The engineering building is a two-story brick structure, 175 ft. long by 85 ft. wide, and is situated at the eastern end of the quadrangle, close to the track of the Colorado & Southern Railway. The entire first floor of the original structure is devoted to the shops, power plant and electrical laboratories, while the hydraulic, cement and mechanical laboratories are located in the basement.

On the first floor are located the office of Prof. Dates, dean of the engineering school, a department reading room for electrical students, recitation, drafting and photometer rooms, an electrical measurement laboratory, dynamo room, machine shop, forge shop and boiler room. The engineering building, in common with all other buildings on the campus, is lighted by electricity and heated from the central boiler plant. The second floor of the entire building, with the exception of the wood-working shop, which is just above the machine shop, is occupied by class rooms, drawing rooms and the studies of the professors of civil and mechanical engineering, superintendent of shops, etc. The electrical recitation room on the first floor contains an instrument case holding about $3,000 worth of apparatus, and an interesting exhibit of samples of wire and cables, rail bonds, the various parts of an incandescent lamp arranged in the order of their assembling in manufacture, and a dissected dynamo which shows every part of the machine in single pieces. There is also a collection of armored conduit, fuses and high-potential insulators.

The photometer room is large and well ventilated, containing a Reichsantalt photometer with a two-meter scale, Bunsen and Lummer Brodhun screens, standards of lamps, etc. The electrical measuring laboratory is well equipped with wattmeters, synchronizers, voltmeters, ammeters, balances, lamp banks, transformers and water rheostats. In the dynamo room are located a 50-hp Ames engine and a Harrisburg engine of the same capacity, a jack shaft with pulleys and a 30-kw, 125-volt, 4-pole, compound-wound, 250-r.p.m. Westinghouse direct-current generator, a 35-kw, 110-volt Akron generator, a General Electric bipolar generator, rotary converter, induction and synchronous motors. A 10-kw Westinghouse rotary is soon to be added to the equipment. There are also water rheostats for taking up loads, lamp banks and switchboards.

The civil engineering laboratory is well equipped with surveying instruments of the various standard makers, transits with solar attachments, mining transits, levels, compasses, plane tables, a sextant, barometers and a good collection of drawings and models used in design work. The cement laboratory is equipped with a 200-pound Fairbanks shot machine, a 100,000-pound Olsen testing machine, molds and tanks. About 1,600 sq. ft. are occupied by the hydraulic laboratory. The equipment consists of a tank in the third story of the building, affording a constant head, and in the laboratory, tanks supplied with various shaped notches and orifices for discharge measurements, channels of various shapes, benturi meters and other pieces of hydraulic apparatus.

The mechanical laboratory uses the testing machine above mentioned, and is equipped with a great variety of oil testing apparatus, calorimeters, injectors, meters, burettes, thermometers, pyrometers, micrometers, steam gauges, anemometers and indicators. The University power plant contains three boilers of 200-hp capacity, pumps, traps, etc., so that tests of fuse economy are arranged with great ease.

While there is ample room in the new building for the installation of much more apparatus, it is gratifying to note that nearly all the equipment thus far purchased is of excellent quality, and of sufficient variety to enable a wide range of experimental work to be carried on. One does not expect to find such complete equipment in the Rocky Mountain States as is here in evidence. All the machinery in the building is driven by electric motors. The foundry contains a Newton cupola furnace, capable of melting two tons of iron per hour, and the forges and cupola are served by three centrifugal fans, operated by a 10-hp motor.

Experiments With the Magnetic Detector.

In the May number of the *Physical Review,* Prof. Arthur L. Foley gives the results of some experiments on the magnetic detector of electric waves which formed the subject of a Royal Society communication made in 1902 by Marconi, which has also been known as the Rutherford detector. The instrument as used and described by Marconi, consisted of a "core or rod of thin iron wires on which were wound one or two layers of thin insulated copper wire. Over this winding insulating material was placed, and over this again another longer winding of thin copper wire contained in a narrow bobbin." One terminal of the inside winding was connected to earth, the other to an elevated conductor. The ends of the outside winding were connected to a telephone. A horseshoe magnet, suitably placed, was moved by clockwork so as to cause a continuous change or successive reversals, of the magnetism of the iron core. Electric oscillations appeared to reduce the effects of magnetic hysteresis, hence the magnetism of the iron core increased or decreased suddenly with each spark of the transmitter, inducing a current in the outer winding connected to the telephone.

Marconi noticed that "the signals in the telephone are weakest when the poles of the rotating magnet have just passed the core and are increasing their distance from it, whilst they are strongest when the magnet poles are approaching the core." To obtain more definite results, Prof. Foley arranged to use a ballistic galvanometer instead of a telephone, and to take readings for various determined positions of the magnet and core.

The core, which was 5 cm. long, consisted of twenty-six pieces of annealed piano wire, .063 cm. in diameter. Over this was wound a single layer of 200 turns of No. 36 silk-insulated copper wire. One end of the coil was connected to a vertical wire 200 cm. long, the other end was put to earth. The terminals of the outer or secondary coil of 1,000 turns of No. 30 copper wire were connected to a Rowland D'Arsonval galvanometer through a key arranged to short-circuit the galvanometer after each throw of the needle. This brought the needle to rest very quickly, and permitted the position of the magnet to be changed without affecting the galvanometer.

The induction coil (one inch) of the transmitter was adjusted to give a 2-mm. spark between two small brass spheres, one connected to a vertical wire 200 cm. long, the other to earth. The distance between the transmitter and receiver was varied from two meters to twenty meters. No effort was made to "tune" the circuits. The primary and secondary coils were fastened in place on a board

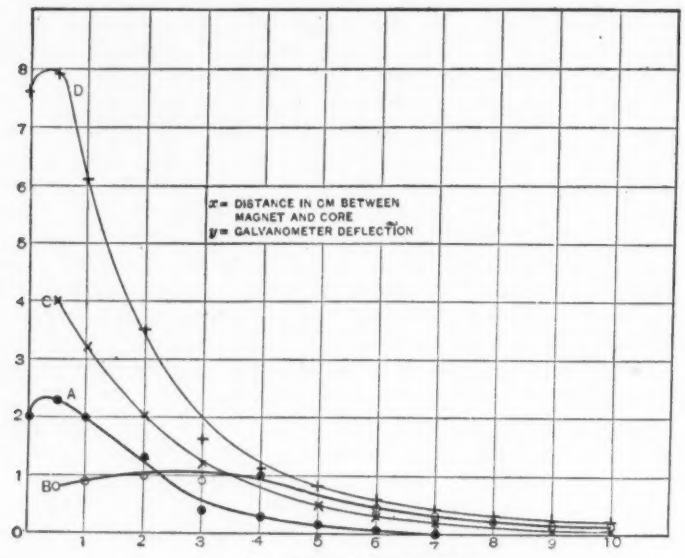


FIG. I.—MAGNETIC DETECTOR.

grooved and graduated so that a horseshoe magnet could be slid back and forth in the same horizontal plane with, and in a direction at right angles to, the iron core, and placed at any desired distance from it. To get a reading the galvenometer was first short-circuited and the magnet placed in position. The short-circuit was then broken, the transmitter operated as long as the deflection of the needle was increasing, and the throw observed.

The curves in Fig. 1 give the throws of the galvanometer for the given distances between the magnet and core as follows:

A. When the magnet is placed 10 cm. from the core and moved one space nearer each successive reading. *B.* When the magnet is placed in contact with the core and is moved one space farther from it each reading. *C.* When the magnet is removed and the transmitter operated between readings. *D.* When the magnet is turned over (the field reversed) between readings.

A comparison of curves *A* and *B* shows that the sensitiveness of the magnetic detector depends upon both the distance and direction of motion of the moving magnet. When the magnet is near the core the detector is more sensitive when the magnet is approaching,

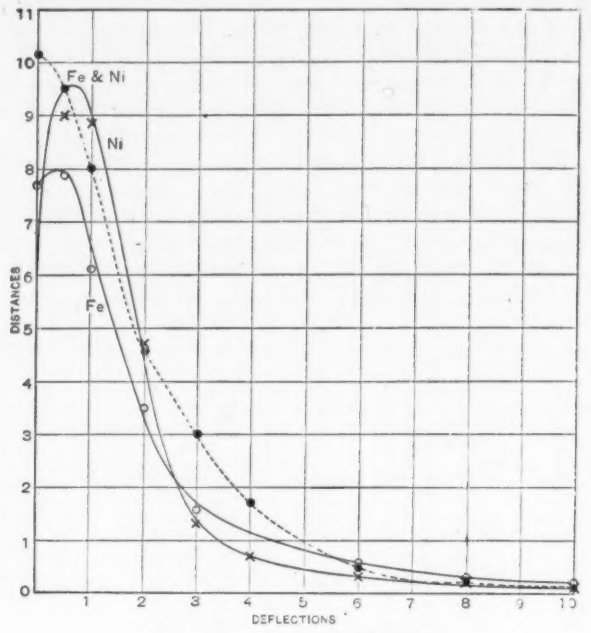


FIG. 2.—MAGNETIC DETECTOR.

but when some distance from the core the detector is more sensitive when the magnet is receding. Both curves indicate a maximum of sensitiveness at a distance from the core, the distance being less when the magnet is approaching. Since nickel is more susceptible than iron in weak magnetic fields, and less susceptible in strong fields, Prof. Foley concluded that a more uniform sensibility for varying distances between the moving magnet and core might be obtained by making the core of nickel.

Four cores were made, each one being 5 cm. long, approximately .4 cm. in diameter and being wound with 200 turns of No. 36 copper wire. Core 1 consisted of 26 pieces of piano wire .063 cm. in diameter. Core 2 of 10 pieces of piano wire and 10 pieces of nickel wire, .082 cm. in diameter. Core 3 of 2 pieces of piano wire and 13 pieces of nickel wire. Core 4 of 14 pieces of nickel wire. The curves of Fig. 2 give the deflections at various distances between the magnet and each of the four cores, the magnet being moved one space at a time and having its poles reversed after each reading.

The sensitiveness of the detector with a nickel core was not very different from the sensitiveness when an iron core was used. Contrary to expectations, however, the sensitiveness with the nickel core appeared to be the greater in strong fields and with the iron core in weak fields. Both showed a maximum of sensitiveness at a short distance from the magnet, the maximum for nickel being the farther removed. The nickel core proved to be more sensitive than the iron core for distances up to 2.5 cm.

When the detector was worked with the mixed core of iron and nickel wires the deflections of the galvanometer increased as the magnet approached the core, even up to the point of contact. The curve (*Fe* and *Ni,* Fig. 2) lies above the *Fe* curve at all points and above the *Ni* curve at most points, showing that a mixed core consisting of annealed piano wire and hard drawn nickel wire, produced a more sensitive detector than was obtained by using a core of piano wire only. The detector gave small deflections of the galvanometer when I used an antimony core; also when a core of iron filings was used contained in a thin walled glass tube. A core of bismuth gave no deflection.

The form of the curves of Figs. 1 and 2 probably depends upon other points than those here considered, as for instance the frequency and intensity of the oscillations of the transmitter, and the annealing of the steel wires used in the core.

Some Telephone Problems in Farming Communities.

By HOWARD S. KNOWLTON.

THE growth of the telephone industry in the United States presents a remarkable evolution of apparatus and methods. It would be difficult to express in a single paragraph the revolutions which the technical side of the art has passed through in its advance from the crude mechanism of the early days to the highly-developed and organized appliances of the present. Although the common-battery, lamp signal, multiple switchboard is one of the latest additions to standard practice, involving many operating and maintenance problems unfamiliar in the first part of the closing decade of the nineteenth century, it is a logical and scientific outcome of all that came before it, and a notable illustration of the pursuit of economy in the modern industrial fabric. There is scarcely a piece of telephone apparatus in existence to-day which may not be improved in some detail but a single year hence, although its fundamental principle may be utilized long after this page has yellowed with age. Even the familiar Bell receiver has been tremendously increased in power by doubling the magnet poles and employing a closed magnetic circuit. Permanence is yet to be printed in the dictionary of telephony.

Urban communities reaped the benefit of the invention of the telephone long before the agricultural districts could avail themselves of it. The experience of the electric railway is a close parallel. For almost twenty years after the electrical transmission of speech was an accomplished fact the farmer had little conception of its possibilities when installed in his home, and still less expectation of being offered a rate within his means. Step by step, however, the telephone system reached out beyond the city, until to-day the market has been brought to the farmer's very door by its agency, and the exploitation of the rural district is increasing by leaps and bounds.

With the extension of the telephone into the country regions has come a serious problem. The cost of construction per subscriber served is unavoidably high, in view of the low density of population, long lines to be built, remoteness of railway or river transportation facilities and expense of maintaining the construction force away from home. The physical obstacles offered by huge mountain ranges and other rough country may easily rise to alarming proportions. Maintenance likewise is a heavy expense, after the lines are placed in operation over extended territory. The adoption of a rate which shall be fair to both company and farmer is, therefore, a question of the first magnitude in importance. Telephone companies the country over are face to face with this pressing problem.

The manner in which the question has been met in the West by one of the most progressive Bell companies in that part of the country is full of suggestion. The writer takes a leaf from the record of the Colorado Telephone Company as the concrete example.

For some time past there has been a feeling among the ranchmen of Colorado that lower telephone rates would be much appreciated. Party line ranch service at a distance of two and one-half miles radially from the local exchange centers has been charged at the rate of $30 per subscriber's station per year, with the exception of ranches located near larger centers of population like Denver, Colorado Springs, Pueblo, etc. This rate, $30, did not increase as the distance from the central office became greater. In the vicinity of Ouray and Silverton higher rates were necessary, in view of the extraordinary wildness and roughness of the mountains in this portion of the State. The region around these two places is called the San Juan country, and while it is famous for stupendous scenery it is no easy place to maintain telephone lines.

The Colorado company, therefore, made a careful study of ranch service, with a view toward meeting the situation. An example of the thoroughness with which this work was done is evidenced by an exhaustive study which the engineering department made in January of the cost of service on the group of lines extending northeast of the town of Longmont, supplying ranches in the region adjacent to Highland Lake. This inquiry involved a careful inventory of every pole, insulator, cross arm, wire, guy and telephone instrument on a lead about 50 miles long; a traffic record extending over a period of one month, in which every originating call on this lead was counted, day and night; and a close examination of all receipts and expenses in connection with the Longmont exchange which had a bearing upon this group of lines.

After the ranch problem had been thoroughly gone over by the officials of the company, conferences were held with prominent ranchmen, and the question of rates gone into afresh. The upshot of the matter was the issuing of a circular letter by the president of the Colorado Telephone Company, Mr. E. B. Field, a copy of which was sent to every ranch subscriber in the State.

Mr. Field entitled his circular "Facts, not Promoter's Promises, Regarding Ranch Telephone Service," and succeeded in making therein a remarkably plain statement of the telephone company's attitude and propositions in regard to the whole matter. Certain portions of this circular are of so much interest to managers of electric properties that I have no hesitation in quoting them, wholly or in part:

"The Colorado Telephone Company wants to furnish the ranchmen of the State with telephone service. The ranchmen in the State want to be furnished with telephone service by someone. It is to be regretted that there has grown up, not only in Colorado, but in the entire United States, a very unfortunate misunderstanding upon both the part of the telephone companies and the farmers as to the attitude of each other on this question. When two intelligent persons, or bodies of men, have a wrong opinion of each other, it usually turns out that neither understands the real position of the other, and it is to try in a business-like manner to clearly and fairly state the facts on both sides that this paper is written."

Mr. Field then made the point that as most people know their own business best, it is safe to say that the employees of the telephone company do not have a skilled knowledge of ranching, and that the ranchmen, on the other hand, are not experts in the telephone business. It is fair to presume that each class of men understand their own business, or they would not long remain in it. A ranchman may have run a telephone line from his barn to his house and bought two telephone instruments, but for this reason he does not necessarily know any more about the question of telephone service than the telephone man knows about farming, because he has raised a few potatoes in his garden.

One of the misunderstandings that has arisen is the farmer's idea that telephone companies are grinding monopolies, intent on fleecing the farmers by extortionate rates to the extent of their ability to do so. "There are people all over the United States who want to sell telephone apparatus, who are constantly catering to and fostering this feeling on the part of the farmers. There is also in every section some sharp, shrewd local man, who will go in with the fellow who wants to sell his telephones and supplies, and advise his fellow towsmen to go into the scheme and then receive a commission himself on the sales, or an interest in any scheme carried out." Mr. Field then quoted an example from the advertising matter which is constantly being sent to the farmers by manufacturers, which advised the farmer "not to be fooled with the sugar-coated pill that telephone companies offer," saying that if the farmer will look closely he "will see the grinning skeleton behind the pill and not be fooled by the blood-thirsty monopoly." The pamphlet quoted then goes on to sing a wonderful song about how much better it will be for the farmer and the entire universe if he will only buy the apparatus of this particular company, and how much better it will be for the farmer if he has no dealings with the local company in his immediate neighborhood. It is astonishing that any intelligent farmer can be caught by such arguments, but "that a certain portion of the farming community do listen to continued assertions like the above is unfortunately true."

"On the other hand, the telephone companies, when met by this spirit on the part of the farmer have also come to the conclusion upon their part that the farmer does not want to pay a reasonable telephone rate for their service, but that they are insistent upon getting something for nothing, and it has been an unfortunate misunderstanding all around." The circular letter then states that the telephone company does not believe that the Colorado ranchman wants something for nothing, neither is he willing to give something for nothing; that the company wants to give the farmers fair rates, and that it has a better, fairer and in the end a cheaper proposition to make than any outsider can offer.

"The price at which anyone can afford to sell a thing is based upon what it costs to raise or produce it. The farmer bases the price of his live stock upon his crops, upon the labor and investment involved up to the day when he offers the stock in market. In the case of alfalfa or sugar beets, for instance, he knows what his product costs him; he knows what it costs to bring water upon the land, the cost of his fences, farm houses, implements, etc.; he must reckon the price of seed, the cost of sowing, weeding, cultivating and har-

vesting; and then he considers the cost of hauling to market. If the crop does not give him a fair profit (and the most profit that the Colorado Telephone Company hopes to make on its business in a year is 6 per cent.) he drops that crop for something better. To the buyer who comes to the ranch and offers to take his alfalfa as it stands stacked in the field, he will sell for less than to the merchant in town who expects him to deliver it to his store, baled and ready for shipment. Were a beet sugar factory to agree to weed, cultivate and come and get his beets, relieving the farmer of all that risk and care, he would sell them for less than he would to a factory that did not do so. The same principles exist in connection with telephone companies.

"What is ranch telephone service? It is not having a telephone, for you can buy one outright for $10 or $15. Telephone service involves a telephone instrument and its care; it means also the digging of holes, buying of poles of suitable timber which will stand up under heavy storms; of first-class insulators, high-grade wire, etc. Then it involves the expense of sending out at any hour of the day, with the cost of livery, a man to repair breaks and set poles, and many times it costs the company $10 to repair a simple trouble on your circuit. You must bear in mind that the best telephone line depreciates and rots continually, and must be entirely replaced at least once in every seven to ten years, so that out of every $100 that we put into line, 10 per cent., or $10, rots away every year. Further, the telephone and the lines are not telephone service, for then comes the town investment and the investment throughout the State, and the operating labor, which enables you to communicate with hundreds of other subscribers; this means a switchboard, taxes, office rent, light and heat; it means the salaries of operators who must be on duty for you night and day, of linemen, and competent men to superintend the business to see that you are properly served."

The propositions of new rates are as follows:

1. Within one mile of the central office the company will furnish the farmer with instruments and care for the same, build all the lines, do all the work, assume entire responsibility and furnish him service inside the district in which the central office is located, at $18 per year. And beyond one mile the following rate will be charged in a small increasing amount, as the distance from the office becomes greater, all distances being measured in a "bee" line, although the distance by road is sometimes far greater: From 1 mile to 1¼ miles, $20; between 1¼ and 1½ miles, $22; between 1½ and up to a 6-mile limit, $24; between the 6 and 9-mile limits, $27; between 9 miles and 12 miles, $30; from 12 to 15 miles, $33; between 15 and 18 miles, $36, and so on. Under this plan the nearer the central office the lower the rate charged. The equity of charging an increased rental as the distance from the office increases should be apparent, because the investment in poles and wire grows greater and greater as the length of line to be built and maintained increases.

"Now, just as you will sell your alfalfa for less to the company that will buy it as it stands stacked in the field, the telephone company has various propositions to offer you if you will relieve it of some of its investment expenses and labor by furnishing part of them." It is assumed that during certain seasons of the year ranchmen have the time to perform the labor of constructing a telephone line, and it is to provide cheaper plans for telephone service, in which the company has the co-operation of the ranchman by his doing certain portions of the necessary labor, and himself owning certain portions of the plant that the following propositions are submitted:

2. This proposition gives a rate of only $12 per annum per station if one or more ranchmen will construct and take care of their line at their own expense, the company furnishing the telephones, taking care of them and giving exchange service.

3. If the farmer will not only construct his line, but also buy his own telephone and take care of it, the company will give him its switching service—exactly the same service which it gives every other subscriber—for 50 cents per month, $6 per year. The company does not ask the farmer to buy a complete telephone instrument, but will loan the subscriber a Bell receiver and transmitter, so that he will only need to buy the balance of the set, either of the telephone company for $10, or wherever else the farmer pleases. The receiver and transmitter will be loaned on a deposit of $3, which will be returned when the apparatus is given back. In case the farmers are so far from town that it would not be practicable to build to the exchange, the company will arrange to place a switchboard at some ranch, centrally located; the company furnishing the switchboard free, and the farmers furnishing the ranch operator at their own expense. The farmers would then build their lines, which would be short, and also maintain them; but the company will keep the switchboard in order, build and maintain the connecting lines from its own central office to the farmers' switchboard, the rental being $12 per annum per station.

4. This proposition provides for a switchboard in the farmer's section, furnished free by the company; maintenance and an operator to be provided by the farmers, who will build their own lines, take care of them and each pay the company $5 per year for the complete telephone instrument; or the farmers may each rent the receiver and transmitter from the company for $2 per year per set, and buy the rest of the telephone instrument; the farmers would then build and take care of the trunk line between their switchboard and the telephone office, and pay 5 cents per talk to the subscribers in the company's exchange.

These propositions cannot be called exorbitant, and are believed to cover any kind of demand which a farmer has for telephone service. The company expects a fair profit if it sells the farmer any of its commodity, and asks him to meet it in exactly the same spirit.

"One of the most seductive songs that is sung to the farmers by telephone supply sellers," Mr. Field states, "is the co-operative idea. These people ask you to form co-operative companies and want you to take a few shares each of the stock so that the farmer may share in any profits that may be made. The Colorado Telephone Company has exactly the same proposition to make to you. The only difference is that you do not have to wait for the success of a doubtful enterprise before you participate in the profits, but can, if you buy stock in our company, buy a stock that has been paying 6 per cent. dividends per annum, and is likely to do so, because our stock has paid 6 per cent. dividends for years. The price of the stock is its par value, $50 per share, and the standing of any purchaser in the company is exactly the same as that of the others who have their money invested in the business." There can be no possible reasonable antagonism between the company and the ranchman after each understands the other's position.

The Colorado Telephone Company earns upon its entire investment from 8 per cent. to 10 per cent. per annum, and reserves the difference between 6 per cent. and its 8 to 10 per cent. as a contingent fund to provide for the havoc that sleet, storms, wind, etc., play with its plant annually. It has no bonded indebtedness, and, therefore, no fixed charges to pay out for interest. This ratio of profit is made upon the existing rates. Mr. Field offers to send a copy of the annual report of the president to stockholders to any ranchman requesting it, and then states that although the business is in the nature of a monopoly, the company has the good sense to know that anything like blood-thirsty or extortionate practices would be business suicide. The argument has been made over and over again by the telephone supply promoter that the company could give lower rates if it did not have to pay such excessive royalties to the Bell Telephone Company for the use of their instruments. Since the expiration of the patents no royalties whatever have been paid. Instead, the payment is a small annual rental for the hand telephone and transmitter, which is actually less than the interest, maintenance and depreciation on the cost of hand telephones and transmitters were these to be manufactured or purchased outright. This rental is in fact an absolute saving to the Colorado company rather than a serious or extraordinary expense. "The promoter has so frequently asserted that he could build telephone lines so much cheaper than the Colorado company that an idea may have gotten into the minds of the ranchmen that we are extravagant in spending our money in telephone construction. The best telephone engineers in the world have stated that the entire plant of the company in the whole State of Colorado, irrespective of sections, could not be replaced to-day at the figure at which it stands upon the books and covering which cost of construction the capital stock has been issued. First-class lines such as this company constructs cannot be built cheaper in this State."

Mr. Field closes by asking the ranchman to choose between the statements of the Colorado Telephone Company and the promoters.

It is evident from the foregoing that the farmer has been met far more than half way by the particular company quoted. Certain it is that the days of concealment are past, if corporations expect to give to and receive fair dealing from their patrons. If the farmer can be made to see just what a company can do he will be much less likely to wage unreasonable war upon it. If the farmer is to

secure the greatest benefit from telephone service, including all the advances which so constantly improve the quality of transmission, speed of connection, etc., he must at least approach the company in an unprejudiced spirit, and the company on its part must be frank and above board in all its dealings. This applies as much to independent companies as to those of the Bell organization. Candor, plain speaking, openness and a sense of mutual positions will go a long way toward solving the vexing problem of rates.

The Zoelly Steam Turbine.

For a number of years Messrs. Escher, Wyss & Co., of Zurich, Switzerland, well known in this country from the use at Niagara of their water turbines, have been engaged on the development of a steam turbine, of which the accompanying illustration shows the general design.

The turbine, which is manufactured under the Zoelly patents, is of the multi-stage impulse type, in which the expansion of the steam takes place in the passages in the stationary parts of the apparatus. Its main point of difference from others of the type is in the construction of the rotors or bucket wheels, which are intended for high peripheral velocities and require correspondingly few stages. The accompanying elevation of a compound turbine shows its general features. The high and low-pressure ends are mounted independently on a single base. The housings are of cast iron or cast steel, divided on the horizontal plane through their axes so that the upper half can be readily lifted off, and the flanges are fitted so closely that no packing is needed. The details of the mounting have been worked out with a special view to avoiding any appreciable displacement of the axis through temperature changes. The housings are covered with non-conductors and steel lagging.

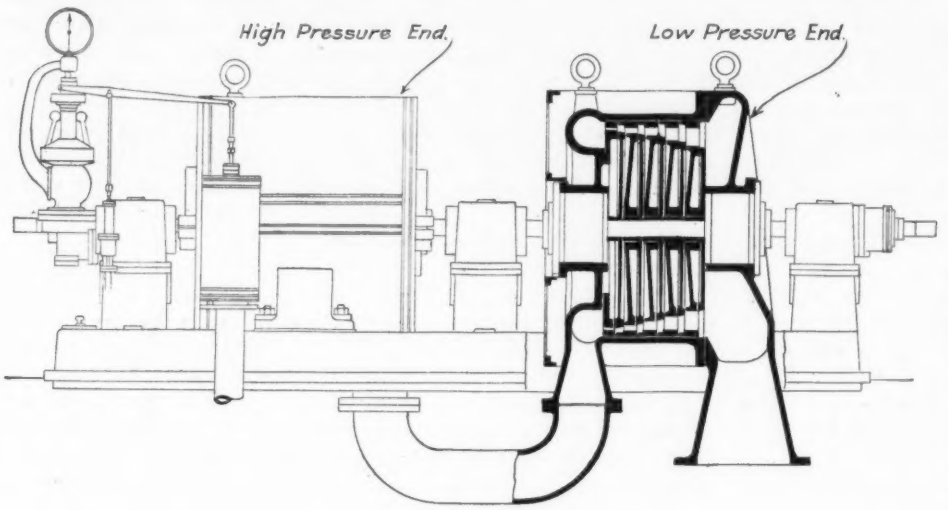


FIG. I.—ZOELLY STEAM TURBINE.

The three main bearings are supported directly by the frame, and are thus independent of the housings. This arangement was adopted to prevent any heating of the bearings by the steam or by conduction from the housings, thus keeping them uninfluenced by the condition of other parts of the turbine. They are readily accessible and easily inspected.

A rotary pump placed on the frame and driven from the main shaft by worm wearing supplies lubricating oil to the bearings. The oil from the bearings is piped to a reservoir in the base, where it is purified and cooled in a coil if necessary, and is then ready for use again. In this way, although the lubrication is profuse, the consumption of oil is kept very low.

The discs of the rotors, of the best Siemens-Martin steel, are keyed to the shaft and have fastened on one side of their periphery a thin ring. This ring forms with the periphery of the wheel a dovetail groove in which the buckets and their spacers are held. The radially located buckets are made of nickel steel, polished to reduce friction to a minimum. Nickel steel is employed on account of its resistance to rust. The discs of the wheels are also highly polished to keep down frictional losses.

It is considered of great importance to have the cross section of the blades decrease from their inner to their outer ends. In this way there is correspondingly small tension due to centrifugal action in the roots of the blades, even with high rotative velocity. In other words, with the same stresses the gradually thinning blades can be made much longer than those of uniform section. The resistance to bending, due to the impact of the steam, is greatest where the bending moment is greatest. The strength of the rotor, in consequence of this design, is so great that a high peripheral speed can be attained, and the number of stages correspondingly reduced, as before stated. This enables the length of the turbine to be diminished and its cost reduced. The steel spacing pieces between the blades have their tops coinciding with the curved surface corresponding to the widening of the steam passage between the blades and consequently form an inner limit for the steam jet. The rotors are carefully balanced and tested at speeds above their nominal rates before they are put in place.

Between each rotor there is a guide wheel or diaphragm in which the guide blades are held. Since the expansion of the steam takes place in these diaphragms between the blades and there is a corresponding excess of pressure on one side of them, each must be steam tight in the housing as well as strong enough to resist the one-sided pressure. Cast steel is used, and the guide blades are arranged in groups in the rim, as shown in the illustrations. Between the groups are thick projecting pieces to which a wrought-iron ring or tire is attached. Th diaphragms are placed close together, the rims touching, and in this way the pressure is transmitted to the end wall of the housing. The hubs of the bucket wheels fit with slight play in holes in the bosses of the diaphragms, the construction being evident from the cuts. The blades have small ears which slip into slots in both the rim of the diaphragm and the outside tire. When they have been slipped into place they are held there by two rings screwed on the low-pressure face, as illustrated. These diaphragms are made in halves, with tight-fitting surfaces, and the upper halves are screwed to the top part of the housing so as to be lifted with it. The shaft passes into and from the housing in stuffing boxes fitted with metal packing.

The governor is a slight modification of the well-known Escher-Wyss regulator used in many water turbine installations. It consists of a ball governor which operates a pilot valve controlling the motion of a plunger directly over the main steam valve and mounted on the same rod. The pilot valve and the chamber of the plunger are connected by two small pipes and the various operations are produced by the discharge of water under pressure through one or the other of the pipes. As this governor is one of the best-known water wheel regulators, it is unnecessary to describe it in detail. The pressure water, or oil, in the case of the steam turbine, is furnished by a rotary pump driven from the main shaft by worm gearing. According to Mr. J. Weishäupl, chief engineer of the company, the regulator has behaved excellently in this new service and the variation in rotative speed, even with the maximum fluctuation in the load, is very slight. Regulation by throttling the steam was chosen as being the simplest method for the purpose. In addition it has the great advantage of not influencing the steam consumption unfavorably at different loads.

If it becomes necessary to furnish more than the rated power of the turbine, the governor operates a valve which admits a part of the steam at the throttle pressure directly into the second and third stages. There is also a safety governor which shuts off the steam in case the number of revolutions rises above the normal to a predetermined limit, such as ten per cent.

In impulse wheels the play of the rotating parts in the casing can be made as great as seems desirable, and for the same reason the axial play between the rotors and diaphragms may be made very large without affecting the working of the turbine. Hence, there need be no fear that in consequence of temperature changes or wear the running and stationary parts may rub against each other. It should be stated that a corrugated bearing like a thrust bearing is employed to keep this free play unchanged.

A ten-stage turbine of this type was put in operation at the works

of Escher, Wyss & Co. last fall. It is rated at 500 hp per minute at 3,000 r.p.m., with steam at 147 pounds. It is directly coupled to a Siemens & Halske dynamo. A surface condenser driven by an independent steam engine is used. Part of the water for the condenser was taken from the city mains and part was pumped electrically from the works well. This renders it very difficult to determine the power needed for the condensing plant. The unit has been tested by Prof. Stodola and Director Wagner of the municipal electric station. They made no attempt to determine the steam consumption of the condenser, and the output of the turbine was figured from the current delivered by the generator. The following statements concerning the test and its results are condensed from their report:

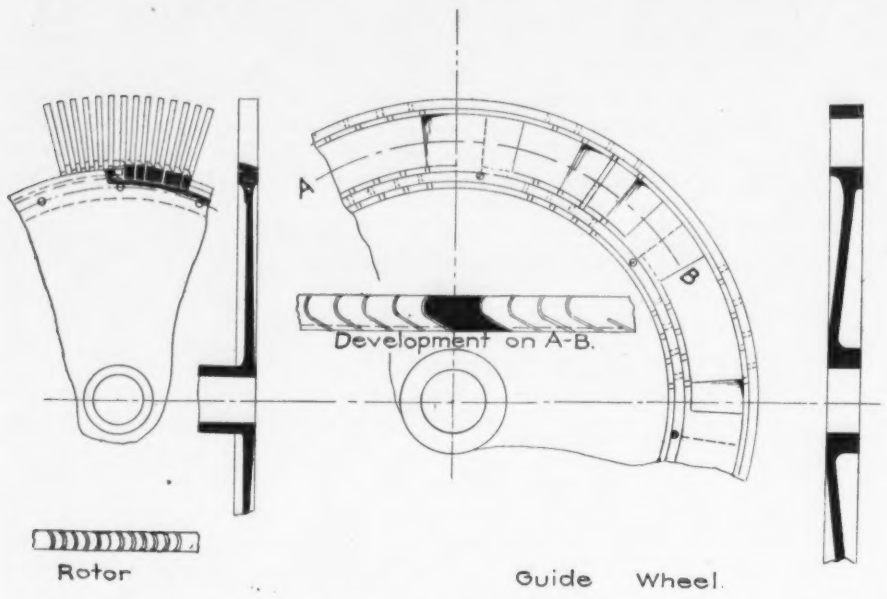


FIG. 2.—ZOELLY STEAM TURBINE.

The pressure and temperature of the steam were observed in the main in front of the separator, which is close to the turbine. During the tests with superheating a thermometer was also placed in front of the throttle valve. The pressure and temperature were also measured immediately in front of the first diaphragm and the pressure behind the first rotor was observed, from which data a check on the feed water determinations was obtained. The pressure in the pipe connecting the two halves of the turbine and the pressure and temperature at the entrance to the exhaust main were also observed. The temperature of the cooling water entering and leaving the condenser and the temperature of the discharge from the air pump were measured. The cooling water was only occasionally measured, while the circulating pump was stopped and the supply obtained through a meter from the city mains. The pressures were determined by manometers which, like the thermometers, were calibrated at the mechanical laboratory of the Federal Polytechnic Institute. The vacuum was measured directly by a mercury column, and the heights reduced to their equivalents at 32° F., a correction which seemed necessary on account of the high temperature of the housings. The revolutions were measured every few minutes by a tachometer. Owing to other uses of the steam from the boiler a measurement of the feed water was useless. In consequence, such determinations were limited to weighing the condensed water delivered by the air pump. This was discharged into an elevated reservoir with inclined bottom, from which it flowed to the scales. The net weight of the apparatus was determined after each emptying, since the readings were restricted to ten-minute intervals. On account of the large capacity of the air pump, more frequent weighing would have resulted in less uniform readings. That a steady operating condition had been reached during the tests was shown by the uniform amount of condensation and the constant temperature of different parts of the turbine.

The electrical measurements were made with instruments calibrated by Prof. Weiss, of the physical department of the Federal Polytechnic Institute. A water rheostat was used.

The turbine was first run with a mixture of moderately superheated steam from one source and saturated steam from another. In front of the separator it showed a few degrees of superheat, but this had practically disappeared in front of the throttle valve. The results of the tests are given in the accompanying table. The first eight are with decreasing loads but a constant speed and steam pressure. The tests were at first arranged in the opposite order, beginning with no load, but the temperature readings of different parts of the turbine showed that a steady operating condition would not be reached for hours. The observations made during the eighth of the tabulated tests show this clearly. In this run the unit was first operated at half load for about twenty minutes in order to warm it up, and two hours afterward the temperatures of the exhaust and of the base of the high-pressure housing were still falling. On this account the computation of the steam consumption is based only on the results of the last thirty-five minutes. With heavy loads, a preliminary run of fifteen minutes was sufficient. The last three tests were made with superheated steam. In all of these eleven runs the turbine operated with very litle shaking of the shaft. The oil for the bearings was delivered at a temperature of 86 to 95° F. and came from them at 104 to 122°.

CONDENSED TABLE OF TESTS OF A FIVE-HUNDRED HORSE-POWER ZOELLY STEAM TURBINE.

Date	Dec. 12, '03	Jan. 25, '04	Jan. 25, '04	Jan. 25, '04	Jan. 25, '04	Jan. 18, '04	Jan. 25, '04	Jan. 25, '04	Feb. 5, '04.	Feb. 5, '04.	Feb. 5, '04.
Length, minutes	180	80	50	50	50	60	60	35	70	20	80
Current, kilowatts	363	388	335	240	182	86	....	....	392	390	390
Revolutions per minute	2967	2967	2977	2983	2984	2995	2995	3000	2972	2973	2968
Before separator:											
Pressure, pounds	149	149	145	147	146	147	147	149	173	178	150
Temperature, degrees Fahr.	369	370	364	366	365	365	365	366	477	497	440
Before first diaphragm:											
Pressure, pounds	133	134	118	87	66	31	3	7.5*	128	128	129
Temperature, degrees Fahr.	356	356	347	329	314	277	228	217	422	427	422
Exhaust:											
Vacuum, ins. mercury	27.7	27.7	27.9	27.9	27.9	28.4	28.4	28.4	27.9	27.9	27.8
Temperature, degrees Fahr.	102	104	102	99	98	91	90	108	100	102	100
Steam consumed per hour, lbs.	7887	8308	7411	5766	4673	2644	1023	650	7438	7319	7712
Steam consumed per kw-hour, lbs.	21.7	21.4	22.1	24.0	25.6	33.0	....	....	19.0	18.8	19.7

* Ins. of mercury.

Iowa State College Branch of A. I. E. E.

In accordance with the desire of the Land and Building Fund Committee of the American Institute of Electrical Engineers that local committees in different parts of the country assist in the work of soliciting subscriptions from Institute members, a committee was appointed by the Iowa State College Branch of the Institute to take up the work in Ames. The committee consists of Messrs. B. S. Lanphear, G. W. Bissell and F. A. Pielsticker. It was decided that each member of the local branch should be asked to contribute something to a joint subscription which should be known as the subscription of the Iowa State College Branch of the A. I. E. E. to the Institute Building Fund.

The committee has been very successful, having raised $700, with several of the local members yet to be interviewed. It is thought that

the interest which has thus been aroused in the work of the Institute will materially strengthen the local organization and thus eventually prove of even greater benefit to the local branch than to the Institute Building Fund.

The Iowa State College Branch of the Institute is in a most prosperous condition. The local membership (which includes "students" of the Institute) now numbers 66. The fact that twelve men have made application for admission as associate members of the Institute since the organization of the branch in the spring of 1903 is a measure of the value of this line of Institute activity.

Recent Electrochemical Developments.

ELECTROMETALLURGY.

The amalgamation process is one of the oldest means for winning gold from ores or sands. In its principle it is a purely mechanical operation. An interesting combination of the amalgamation process with electrolytic extraction is described in a patent granted to W. J. and J. J. Jory (May 24). The inventors introduce with the ore to be crushed a solution of mercuric chloride and sodium chloride into the mortars of the stamp batteries; the pulverized mixture is then carried directly through the screens onto the amalgamating tables by a current of water and there subjected to electrolytic action, the amalgamating plates being connected to the negative pole of the supply circuit. The inventors describe in detail apparatus for this purpose and some modifications of this general principle.

An electric furnace process for making aluminum sulphide simultaneously with an aluminum alloy is patented by M. Onda (May 24). The ore containing aluminum oxide is well mixed with charcoal or coke and a metallic sulphide or sulphate whose heat of formation is lower than that of the corresponding aluminum salts. This mixture is subjected in an electric furnace to heat of about 2,000° C. and the aluminum is converted into the sulphide, while the other metal is desulphurized and absorbs a certain quantity of the aluminum which is not sulphurized, producing an aluminum alloy, while the carbon goes off as carbon monoxide. The inventor describes the application of this principle to the treatment of Arkansas bauxite and iron sulphide for the production of aluminum sulphide and a rich aluminum-iron alloy.

ELECTROCHEMICAL METHODS IN ORGANIC CHEMISTRY.

The application of electrochemical methods for the cheaper and often more direct production of organic compounds has been a favorite subject of investigation during recent years, especially in the research laboratories of the larger German chemical works. Two patents of this class were issued on May 31, both being assigned to Boehringer & Soehne in Mannheim.

M. Buchner formerly described a process of electrolytic reduction of nitro compounds, in which the latter were placed in the cathode compartment of the cell and reduced in an acid solution in presence of tin. The tin acts here as a catalyser. He has now found that lead may be substituted for tin, and describes the following two applications: reduction of nitrobenzine to analine by the addition of lead chloride to the catholyte; and reduction of nitrobenzine to analine by addition of metallic lead to the catholyte.

W. Loeb has studied the preparation of azo dyes. Azo compounds are generally prepared by dissolving or suspending an amine in acid solution, diazotizing the same at a low temperature by means of a nitrite, and mixing the diazotized solution with the solution of a "coupling" compound. Loeb has now succeeded in preparing azo dyes electrolytically in one process by combining diazotation and coupling of the amine with a compound of acid character in the same solution under the influence of the current.

BATTERY INVENTION.

There are again quite a number of new patents on batteries; as usual they refer to details. E. W. Smith, of the Electric Storage Battery Company, of Philadelphia, patents a grid having the faces of its respective openings covered by a perforated sheet and describes in detail means for securing the perforated cover plate to the grid.

A. Meygret patents a grid made of an end piece to which various strips are secured, definitely separated one from the other a small distance apart. Each strip has on each outer face a receiving surface for the active material, the receiving surfaces running parallel with the outer side faces of the end piece of the plate.

T. A. Willard patents details of construction of sheaths or envelopes for containing and separating the plates of a battery.

H. P. R. L. Poerscke and G. A. Wedekind patent the following method of making a hard porous metallic (copper) electrode, which is claimed to be insoluble in an alkaline solution. The inventors mix pure oxide of copper and finely pulverized copper with a solution of protochloride of copper without the addition of foreign substances. The pasty mass thus obtained is placed in a mold and heated until dry. The electrode is then reduced to metallic copper in an alkaline solution until all the bound chlorine is set free, whereupon the substance is again oxidized by heating or electrolysis.

New Telephone Patents.

The telephone field is represented by but two patents this week. Of these one covers a receiver support and the other an improvement in a certain form of step-by-step selective system.

The receiver support is the invention of G. A. Cowgill, of Euphemia, Ohio. The supporting arm is hinged so that when the receiver is not in use it will be naturally folded back out of the way. This folding back of the receiver automatically depresses the switch hook; the rearward portion of the supporting arm is pivoted and linked to the switch arm and the position of the center of gravity of the system is shifted across and above the pivot as the receiver is thrown back out of the way.

The selective system improvement refers to a step-by-step system in which automatic return of the selectors at all stations is accomplished by electrical means as soon as the receiver of the last selected station is returned to the hook. With this system as previously designed it has been found that when two party lines have been connected together, the current impulses upon one line might become effective upon the other in a manner to defeat the whole system. For example, suppose *A* of a five-party line connected to *D* of a second five-party line. Both restore the receivers to the hook switches, when upon each line automatically a series of impulses begins, each such impulse moving the selective devices one step toward the zero position. The series of impulses upon each line should decrease when the zero joint of the selector is reached. If, however, there is overlapping from line to line then one selector will be moved past its zero, due to impulses received from the other line. To overcome this certain short-circuiting devices are introduced in the cord circuit as soon as restoration to zero begins. A. J. Springborn, of Cleveland, Ohio, has obtained the patent for this arrangement, which is applicable to a selective system previously invented by him.

CURRENT NEWS AND NOTES.

A LONG TELEPHONE LINE.—The Bell Telephone Company, of Kansas City, has begun preparations for a long-distance line between Kansas City and Joplin, to connect with a new line that is being built from St. Louis to Joplin, and thence through the Indian Territory into central Texas. Over $1,000,000 has been appropriated for these extensions, which, with the Bell connections east of St. Louis, will make the longest telephone line in the world.

MILEAGE OF CANADIAN RAILWAYS.—The report of the Dominion Minister of Railways gives the length of the railways in Canada on June 30, 1903, as 19,836 miles. Of this 19,077 miles were operated by steam and 759 by electricity. The latter includes the street as well as the suburban and general lines, which are growing with rapidity. More than two-thirds of the railways of the country are owned and operated by the government and four companies.

WIRELESS TELEGRAPHY ON THE PACIFIC.—A telegram from San Francisco May 23 says: "For the first time on the Pacific coast communication has been had by wireless telegraphy between a ship at sea and points on shore. The United States hospital ship *Solace* sailed from this port Saturday, and until she was 70 miles out messages were sent between the *Solace* and the Weather Bureau's station at Point Reyes on the mainland and on the Farallone Islands, which lie off this city. Conditions were very favorable, and communication was continued without a break for five hours."

NEW WIRELESS TELEGRAPH SYSTEM.—It is stated that Prof. William Hamill, of the Normal Industrial College, at Greensboro, N. C., has invented a simple and practical system of wireless telegraphy, and that it has been tested at the Johns Hopkins Hospital in Baltimore. It is to be installed at the Normal College.

ELECTRIC RAILWAY TESTS.—A comprehensive series of tests is being conducted at the power house of the Lexington (Ky.) Street Railway Company on a storage battery auxiliary recently installed. Prof. W. E. Goldsborough has supervision of the tests, which are being conducted by Prof. A. N. Tapping, of Purdue University, assisted by Messrs. West, Waldron, Hinsley and Goodspeed, students of Purdue. Mr. W. W. Donaldson is present as representative of the manufacturers of the battery, the Gould Storage Battery Company.

IN THE HOSPITAL.—Patients in a hospital often have to endure long, weary hours, and an experiment made recently at the Samaritan Hospital, Philadelphia, suggests a means of beguiling pain and tedium. Through a combination of telephones with megaphones attached to the receivers patients throughout the hospital were enabled to hear the hymns sung at the service in the Baptist Temple, many squares away. The sermon of the pastor was also transmitted to the hospital and was heard as distinctly there as by the people who were occupying pews in the church.

WIRELESS TELEGRAPHY AT THE SEAT OF WAR.—Following the recent manifesto of the Russians regarding wireless telegraphy at the seat of war, a special dispatch from Tokio to the New York *Sun*, a copy of which follows, will naturally excite some curiosity: "It is suspected that the Russians at Port Arthur are communicating with Chinese territory by means of wireless telegraphy, their instruments probably being on some small islands off the coast. The Japanese cruiser *Chitose* discovered four masts showing above Liaotishan, but they were out of range of her guns."

SECOND GERMAN-AMERICAN CABLE.—The laying of the second German cable from Borkum to New York by way of the Azores was completed on Wednesday last week. The cable was laid by the steamer *Stephan*, which left New York on May 10 with 2,100 nautical miles of cable on board. She began to pay out on May 11 from a point off Fire Island. The shore end between Fire Island and Coney Island, where the American end of the cable is landed, had already been laid. The final splice was made off Fayal. The cable was manufactured at Nordenham by the Norddeutsche Seekabelwerke. The total length is 4,200 nautical miles. The first German cable was laid five years ago.

I. E. E. AMERICAN TRIP.—Circulars have been issued to the members of the British Institution of Electrical Engineers outlining the American trip this summer. At present the proposed delegation is not less than 100. It is intended that the party shall leave Liverpool on the White Star steamer *Republic* August 25 for Boston, at which port she is due on Friday, September 2. The party is to reach New York September 4 and start out by special train for the St. Louis Electrical Congress September 6. The total cost, including ordinary extras, is put at $450. A large party from Italy is to arrive directly in New York about August 31. Generous provision is being made on this side at various points for the reception of the visitors from abroad, of whatever nationality. The Congress bids fair to be a great success in attendance and papers.

UNIVERSITY OF MINNESOTA GRADUATING CLASS.—Nearly all of the class graduating from the electrical engineering course at the University of Minnesota are located, many of them being already at work. E. J. Cheney, V. E. Goodwin and F. C. Helms enter the engineering apprenticeship course with the General Electric Company at Schenectady. J. Howatt, F. A. Otto and R. B. Taplin enter the engineering apprenticeship course with the Westinghouse Electric & Manufacturing Company at Pittsburg. L. C. Tomlinson and J. Wicks go with the Automatic Electric Company at Chicago. G. Crabbe goes with the Otis Elevator Company at Yonkers. H. G. Morton goes with the Northwestern Telephone Exchange Company at Minneapolis. B. M. Bouman will enter the telephone field. P. M. Rosok goes with the Missouri River Power Company at Helena.

NON-RESIDENT ELECTRICAL ENGINEERING LECTURES, UNIVERSITY OF MINNESOTA.—Following is a list of the lectures by practicing electrical engineers, delivered at the University of Minnesota during the college year just closing: Edward P. Burch, consulting engineer, Minneapolis, "Speed Torque Characteristics of Steam and Electric Locomotives"; Lee M. Coleman, electrical engineer, Minneapolis, "Experiences of an Installing Engineer"; Jake Danner, telephone engineer, Western Electrical Company, Chicago, "Telephone Cables"; Charles E. Downton, foreman of apprentices, Westinghouse Electric & Manufacturing Company, Pittsburg, "The Training of Engineering Apprentices in an Electrical Manufacturing Plant"; Locke Etheridge, district engineer, Stanley Electric Manufacturing Company, Chicago, "The Engineer Salesman"; Truman Hibbard, chief engineer, Electric Machinery Company, Minneapolis, "Commercial Features of Dynamo Design"; Charles L. Pillsbury, consulting engineer, St. Paul, "Design and Construction of the Municipal Electric Lighting Plant at New Ulm."

TRACKLESS TROLLEYS IN GERMANY.—Mr. C. L. Cole, United States Consul-General at Dresden, Germany, says: "For several years experiments have been made in Germany with railless electric roads. Among the lines which have come to my notice are several in Westphalia and two in the vicinity of Dresden—the so-called "Haidebahn," connecting with an electric tramway terminus at the outskirts of the town, and the "Königsstein" road starting from Königsstein, a town lying on the Elbe about 12 miles above Dresden. A large proportion of the passengers carried by both lines are tourists or Sunday strollers. The Haidebahn covers a distance of 3.1 miles. Wagons run every half hour, the fares being 10 pfennigs (2.38 cents) for the shortest ride and 20 pfennigs (4.76 cents) for the full distance. The Haidebahn runs over a slightly undulating road, while the one at Königsstein covers about two miles of hilly highway. The speed of coaches varies considerably with the slope of the road, not, it seems, because of a lack of motor force, but for the sake of the comfort of passengers and the reduction of wear and tear on the machinery. It seems that neither of these two lines has proved a marked success from a financial point of view, partly because of the expense in operating. The electric energy required to move cars over dirt roads exceeds by 100 per cent. the power necessary to draw cars over iron rails, and this difficulty should be carefully considered by parties in the United States who contemplate similar enterprises." Another line of this general character, the first in Prussia, is being built between Monnheim and Langenfeld. 2½ miles in length.

LETTERS TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

SIRS:—I have noticed the articles that have appeared in your journal concerning the metric system, and I wish to express my approval of the stand that you have taken in regard to this matter. I am sure that there are many readers of your paper who agree in this statement. Among the older engineers there are of course those who have not learned much about the metric system and who will not favor its adoption; but as sure as the law of the "survival of the fittest" is true, the time is not far off when the system will be adopted in the United States.

STEPHENVILLE, TEXAS. JOHN D. BOON.

Phenomena of the Electric Arc.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the article appearing in your issue of May 21, 1904, by Prof. Charles Proteus Steinmetz on the new magnetite arc lamp, and the interesting discovery by the General Electric Company at its electrochemical laboratory that the arc is fed by material from the negative electrode and not from the positive, as appearances have heretofore led us to suppose.

In carrying out extended experiments for some months past on my current interrupter, illustrated and described in your columns in November last, I have also observed that the arc flame is fed by the vapors from the negative electrode. I find by replacing the nega-

tive carbon electrode by other conducting substances, that the main current does not always readily follow the condenser discharge, while on reversing the current without altering the adjustment of the apparatus in the least, the current follows instantly. Varying the effective area of the negative pole causes a corresponding variation in the current through the gap.

The article in question also states that the great temperature at the positive electrode is due to its being struck by the material from the negative electrode, which issues therefrom at a high velocity. There is a possibility of this statement not being entirely correct, as on this theory the temperature of the negative electrode should equal, if not exceed, that of the positive electrode; for it is reasonable to assume that the negative particles have not acquired any added velocity during their passage through the gap, and also that the greatest temperature is always at the positive pole, no matter what the distances between the electrodes may be.

My theory of the high temperature generated at the positive pole in the ordinary arc is that it is due to local currents set up in the crater by the presence therein of the negatively charged material thrown off or otherwise detached from the negative electrode. I intend in the near future to contribute an article on my experimental observations of the electric arc, but for the present will make this letter suffice.

NEW YORK. THOMAS J. MURPHY.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo.—WINKELMANN.—An illustrated account of a test of a direct-current dynamo, the feature of which is the construction of the armature. It is shown in Fig. 1. The armature

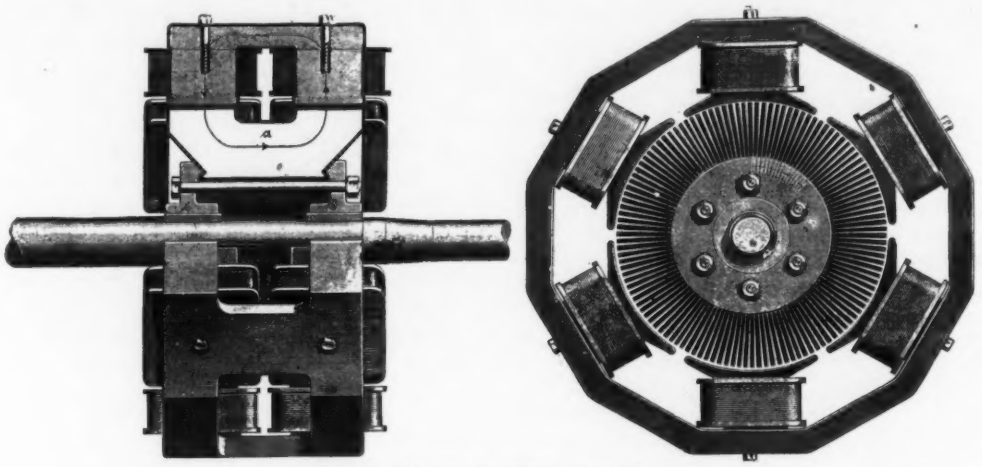


FIG. 1.—DIRECT-CURRENT DYNAMO.

consists of radially-arranged packages of iron sheets, *a*, which are pressed together by means of *b*. The direction of the fluxes in the armature, which is indicated by the arrow, is essentially parallel to the axle and is produced by two neighboring magnet cores. On account of the construction of the armature there are small spaces, δ, which are partly filled by the armature copper. According to the size of the machine, four or more pairs of poles are used. The author thinks that this type has some advantages over the usual type. He tested the machine as motor, the continuous load being 37 kw; the armature current was 151 amp. and the increase of the temperature of the armature 28.7° C. The machine was excited separately with 601 watts and the temperature of the exciting coils was increased by 59°. The voltage at the terminals was 244.5 at 607.7 revolutions. The efficiency was 89.2 per cent. The self-induction of the armature is comparatively low on account of the numerous air-gaps in it. For this reason the commutation was very good, without any sparks either at no load or at full load. There was no shifting of the brushes which were placed in the neutral zone. The author says that the machine could be loaded continuously with 190 amp. without reaching a dangerous temperature, and without sparks at the brushes. The weight per kilowatt was 32 kg. for 33 kilowatts load and 25.2 kg. for 41.8 kw load. The author thinks that this construction of the armature, which was devised by Koppelmann, could be also used for alternators.—*Elek. Zeit.*, May 19.

Repulsion Motor.—HANCHETT.—An article giving from a non-mathematical standpoint the characteristic features of the repulsion motor. Since the repulsion motor is somewhat like a transformer, commutation difficulties can be minimized by winding a motor for as low a secondary voltage as practicable and by the introduction of leads having sensible resistance between the commutator bars and the coils with which they are connected. As one of the best features of the repulsion motor he considers the fact that the speed can be controlled simply by adjustment of the brushes.—*St. R'y Jour.*, May 28.

POWER.

Electric Power in Metallurgical Plants.—The first part of a profusely-illustrated article on electric aerial suspended tramways for quickly transporting materials from one part of a metallurgical plant to another. The system described is that of Kolben & Co. for special use in iron and steel works.—*Elek. Bahnen.*, May, No. 10.

Electricity for Mine Hoists.—An illustrated article on electrically-operated versus steam-driven mine hoists. Some examples from various plants are described. The losses in steam pipes, operating pumps, ventilators, hoists and other mining machinery by engines of small capacity, as well as the low efficiency of these engines, make it desirable to utilize electric power wherever possible.—*Scient. Am.*, June 4.

Lifting Magnets.—PERKINS.—An illustrated article on the construction of Belgian and American electromagnets for lifting heavy pieces of iron and steel.—*Scient. Am.*, June 4.

Steam Turbines.—DRIN.—The first part of an illustrated summary of the development of steam turbines. In the present installment he gives a short history of the subject and then classifies various types of steam turbines.—*La Revue Elec.*, May 15.

TRACTION.

Storage Battery Locomotive.—PASSAUER.—An illustrated article on the use of storage battery locomotives. They are specially useful in switch yards where a trolley line would be difficult and expensive. Compared with a steam locomotive, the storage battery locomotive has the advantage of being always ready for service, and its cost of operation is smaller if the locomotive is used at irregular and longer intervals. The high weight of the batteries is an advantage, since a considerable weight is necessary for adhesion. The author describes the first storage battery locomotive which has been built for such purposes for the Prussian State railways. The battery consists of 200 cells with a capacity of 184 amp.-hours, if discharged in two hours. It is charged once a day. Twenty cells are placed together in a wooden box, which is covered with an acid-proof insulating coating. These wooden boxes are well insulated from each other and from the locomotive by means of porcelain rolls. For charging the battery at 110 volts, the cells are connected in five groups, each of 40 cells in parallel. After the charge is completed the cells are all connected in series, so that an average discharge

voltage of 360 to 410 is available. The charge takes place with constant current and with resistance regulation. The controller is arranged for series parallel control. The total weight of the locomotive is 26,840 kg., of which 10,000 kg. is the weight of the battery and 4,340 that of the other electric apparatus.—*Elek. Bahnen.*, May, No. 10.

Berlin.—An illustrated article on recent elevated railway practice in Berlin. He states that the cost of the ornamental Berlin elevated railway was less than $200,000 per km. and describes various experiments which have been made to reduce the noise. Felt was first tried under the rails, then the car wheels were filled with wood; felt was placed on each side of the rails; then experiments were made with ties of steel and wood which rested on fine sand in transverse steel troughs; then the floor planks were lined with cork blocks. None of these methods, however, was so effective as when low rails laid on deep wooden stringers were employed. He gives some particulars on the last track construction and on the car design. —*St. R'y Jour.*, June 4.

Circuit-Breakers on Double-End Cars.—Gough.—An illustrated discussion of the methods available in wiring circuit-breakers. He believes that the parallel connection is the simplest, although requiring two circuit-breakers and two choke coils. The series connection is popular where non-automatic circuit-breakers are used. The trolley connection would not be countenanced in practice, because the motorman on the front end would have no assurance that by throwing the breaker at his end the power would be cut off, as the breaker at the other end of the car might have been left in.—*St. R'y Jour.*, May 28.

Sub-Station.—An illustrated description of a new sub-station of the Denver & Northwestern Railway at Clear Creek Junction, Colo., where two branches of the system join. Current is transmitted to this sub-station at 2,200 volts, three-phase, from Denver, about 9 km. distant. The sub-station is furnished with two six-phase, 25-cycle, 600-volt, 500-kw, 500-r.p.m. rotary converters. The 2,300 to 430-volt transformers are of the air-blast type and are arranged in two banks of three each, delta-connected. Each transformer is rated at 185 kw.—*St. R'y Jour.*, May 28.

REFERENCES.

Mountain Railway.—Armknecht.—The conclusion of his illustrated description of the mountain railway to Hohensyburg, which was already noticed in the Digest. He discusses the rolling stock and gives a description of the electric signal apparatus used.—*Elek. Zeit.*, May 19.

Locomotive Repair Shop Practice.—A communication in which the writer refers to his visit to a large locomotive repair shop. He calls attention to the fact that with the general introduction of electric locomotives much of the complicated machinery now required in railway shops will be unnecessary. He also refers to the matter of fire protection and states that in the shop visited several electric motors were allowed to run exposed to dust, shavings and chips, despite the danger of fire from sparking.—*St. R'y Jour.*, May 28.

Emergency Car Lighting Equipment.—An illustrated description of an auxiliary car lighting system consisting of a number of extra lamps, a storage battery and an automatic switch. The switch and battery are in series with and usually receive current from the regular 500-volt circuit. When the trolley current is interrupted from any cause the switch automatically throws the storage battery into the auxiliary circuit, and as soon as the trolley circuit is restored automatically throws off the current from the auxiliary lighting circuit.—*St. R'y Jour.*, May 28.

Peru.—An article on the first electric railway in Peru, which is about 32 km. in length. Current is supplied from the local lighting station. to which power is transmitted from a hydraulic plant 56 km. distant.—*St. R'y Jour.*, June 4.

Installations, Systems and Appliances.

REFERENCES.

Protection Against Danger from Breaking Overhead Conductors. —Montpellier.—An illustrated description of apparatus, devised by Giraud to prevent the danger from the rupture of overhead electric conductors. He utilizes the mechanical tension set up during rupture in order to set in action a device which makes a short circuit either with the earth or with another conductor, with the result that this short-circuit acts immediately on an automatic interrupter installed at the beginning of the line or of the section. Various applications of this principle are described.—*L'Elec.*, May 21.

Power Station Design.—The first part of a full account of the extended discussion of Merz and McLellan's paper on power station design which was recently abstracted in the Digest. Diagrams are given of the general arrangement of power stations in Edinburgh and Marylebone.—Lond. *Elec.*, May 20.

Wires, Wiring and Conduits.

Eddy Currents in Cable Sheaths.—Addenbrooke.—In the discussion of Field's recent paper on this subject he describes some experiments made by him and intended chiefly to go into the question of dielectric hysteresis. One set of cables had a bare lead sheath and was coiled on drums. An attempt was made to measure the dielectric losses in this concentric cable between the inner conductor and the lead sheath. The losses were, however, so considerable that it was useless to continue the experiment in this form; the lead acted as the secondary of a transformer to a degree that heavy and considerable losses took place in it. This shows that lead-covered cables carrying alternating currents should not be laid in metallic connection with conductors which may form a return circuit. Another observation was as follows: Several measurements having been made on lengths of cable which were unarmored, an armored length was substituted, and in this the losses were uniformly higher than in similar cable made of the same materials, but which was unarmored, the cables being concentric in both cases and the tests taking place between two conductors. At 3,000 volts the power factor was 1.45 per cent., while with armored cable it is 1.62 per cent. In these experiments the current flowing through the cable was merely the current used for electrostatically charging it, and consequently the effect would be very small. With the actual currents flowing in practice through the cable it is quite possible that the effects might be very appreciable. The only way to determine them would be to take a length of cable having a non-inductive resistance at one end in which the energy of the current passed through the cable would be dissipated. If then a steady alternating current was passed through the cable and simultaneous measurements could be taken at both ends, both of the current and watts lost, deducting the calculable loss in the conductor of the cable it ought to be possible to arrive at any other losses which may take place.—Lond. *Elec.*, May 20.

REFERENCE.

Power Transmission Cables.—Schmidt.—The conclusion of his long illustrated serial on the construction and manufacture of power transmission cables. He gives some diagrams showing the increase of the total weight and of the cross-section of cables with increased voltage of supply.—*Elek. Anz.*, May 19.

Electro-Physics and Magnetism.

Secondary Röntgen Radiation.—Barkla.—An account of an experimental investigation of the energy of secondary Röntgen radiation. The character of secondary X-radiation from gases differs slightly from that of the primary producing it (from air the secondary has a great ionizing power in air). The penetrating rays are transformed to a greater extent than the more absorbable rays. The energy of secondary radiation from a given gas through which a primary beam of given intensity is passing is independent of the character of the primary radiation. The energy of secondary radiation from gases and those light solids which are the source of the radiation differing little in character from the primary, is proportional to the quantity of matter through which the primary beam of given intensity passes. In the passage of X-radiation through air at zero degrees C. and at 76 cm. of pressure, the diminution of intensity due to secondary radiation is of the order of magnitude 0.02 per cent. per centimeter; this is a large fraction of the total loss of intensity due to all causes for fairly penetrating rays. Applying the experimental results to the explanation given by J. J. Thomson for the loss of energy per centimeter (due to radiation) in passing through a medium containing ions, and taking the negative corpuscles with $e/m = 7 \times 10^6$ and $e = 10^{-20}$ as the sources of the radiation, the number of these corpuscles per c.c. for air under normal conditions is of the order 10^{22}. Quantitative results show that the secondary radiation for metals, though of different penetrative power, is of the same nature as the primary X-radiation.—*Phil. Mag.*, May.

ELECTRO-CHEMISTRY AND BATTERIES.

Metallurgy of Gold in South Africa.—DIXON AND TORRENTE.—A very complete account of the development of the metallurgy of gold on the Rand gold fields. The first mill, consisting of only five stamps, was installed in 1887; in 1890 the chlorination process and the MacArthur-Forrest cyanide process were introduced. The introduction of the latter revolutionized the whole aspect of the industry and enabled many low-grade propositions which could otherwise never have been worked at all to pay handsome dividends. The authors give a review of the treatment of sands and slimes and deal at length with the problem of precipitation. In 1894, when the Siemens & Halske electrolytic process was introduced, its main advantages were that a 2 per cent. royalty was charged and that very weak cyanide solutions could be used, while for the zinc precipitation process a 10 per cent. royalty was charged and very strong solutions were used. Later, however, the MacArthur-Forrest patents were upset and the consideration of a 10 per cent. royalty was no longer a factor in the case. The great rivalry between the advocates of both processes resulted in many improvements. The zinc precipitation process was especially improved by the introduction of the zinc-lead couple with the addition of a strong free cyanide solution at the head of the precipitation boxes, according to Betty's suggestion. The authors then give a great many details on the working of the Siemens & Halske electrolytic process by which in 1903 were treated 239,385 tons of sands or tailings which produced 54,794 ounces fine gold; and 129,137 tons of slimes which produced 17,370 ounces fine gold. At present the zinc process seems to have slight advantages, but even now the variations in costs and results between the two processes are very slight, and although at present the zinc process shows a slightly better average in precipitation, the opportunities for losing gold throughout the various operations before eventually producing a lead bullion for cupelling (which is obtained first hand in the electrolytic method) must go a long way toward counterbalancing its advantages. The ideal process which is still sought is one that will precipitate gold from its solution down to say 4 grains per ton with a moderate-sized plant, will produce no by-products, and a bullion bar must be obtained in a simple manner and of a high standard of fineness. The authors then discuss the treatment of the by-products.—*Electrochem. Ind.*, June.

REFERENCE.

Electrolytic Process for Winning Copper from the Ores.—THOMPSON.—A full account of an extended investigation of the Siemens electrolytic process for winning copper from the ores. He first discusses the dissolving action of ferric sulphate on various copper compounds; he describes experiments made with cupric oxide, cuprous oxide, cuprous sulphide, iron oxide and a natural copper ore. He finds that copper pyrite is not appreciably attacked by ferric sulphate; roasting so changes the ore that nearly all the copper can be extracted either by sulphuric acid or by ferric sulphate; this makes it seem probable that roasting changes the copper largely over to the oxide. He then discusses the electrolytic part of the process and deals separately with the reduction of the copper on the cathode and the oxidation of the iron at the anode. The results are given in diagrams and tables.—*Electrochem. Ind.*, June.

UNITS, MEASUREMENTS AND INSTRUMENTS.

System of Units.—KENNELLY.—A communication referring to the recent suggestion of Robertson. He first remarks that it is open to question whether the c.g.s. electromagnetic system is really based, as assumed by Robertson, upon four fundamental quantities, namely, length, mass, time and magnetic permeability. The c.g.s. system is rather based only upon length, mass and time, while permeability is thrown in at present because its dimensions in terms of the other three quantities are not yet determined. As soon as the dimensions of permeability are realized, the term will disappear in the modification of the dimensions of the units where now it comes in evidence. He also thinks that it is now too late to uproot the c.g.s. system and replace it with the meter-kilogram-second system.—Lond. *Elec.*, May 20.

Fessenden.—A communication in which he expresses himself strongly in favor of rationalizing the units by taking the ampere current as the unit difference of magnetic potential and the magnetic line as the unit of magnetic quantity. This will give a rational system and will entirely eliminate irrational quantities from our present calculations. He pleads that every effort should be made at present to rationalize the units; if this should be impossible, no effort must be spared to prevent the establishment of legal units of magnetic potential and of magnetic quantity. If the present theoretical units—i. e., 4π magnetic lines—be made the unit of quantity, the $\frac{1}{4}\pi$ ampere-turns be made the unit difference of magnetic potential, we will cut ourselves off absolutely for several hundred years from having a set of rational units. There is no necessity of manufacturing names for the physical quantities, because if we write these physical quantities in terms of their dimensions, with a suitable prefix to denote whether the quantity is an electric, magnetic or a gravitational one, we get names which have the advantage that they not only uniquely describe the quantity, but also give its dimensions.—Lond. *Elec.*, May 20.

Thermal Instruments for the Measurement of Large and Small Alternating Currents.—DUDDELL.—A British Physical Society paper describing three thermal instruments. The first is essentially a sensitive Ayrton-Perry twisted strip ammeter which is very quick in action for a thermal instrument and has been used for observing and recording potential differences and currents which varied as rapidly as one per second. It is compensated for change in the surrounding temperature by forming the sides of the frame which holds the twisted strip with the same wire that the strip itself is made from. He exhibited an instrument which for a current of 22 milliamperes gave a deflection of one-quarter of the scale distance, i. e., 250 mm. at one meter scale distance. The mechanical periodic time is only about $\frac{1}{5}$ second. Using this instrument in series with a high resistance, he has made observations on the variations in the voltages of alternators caused by cyclic irregularity of the engine. By working to a false zero it is easy to obtain 10 mm. change in deflection for one per cent. change in the potential difference. The second instrument described by him is called a thermogalvanometer. It consists of the combination of a ratiomicrometer of the Boys type with a very small resistance which is heated by the current to be measured, and which in turn heats the thermojunction of the radiomicrometer by radiation and convection. The principle of its action is as follows: A loop of wire has its two ends fixed to the two bars of a single thermojunction, a mirror is fixed to the loop and the whole is suspended in a magnetic field by means of a quartz fibre. The heat from the resistance raises the temperature of the thermojunction and causes the current to flow round the loop, which is deflected by the magnetic field. The sensibility of the instrument depends upon the resistance of the heater. Using a heater having a resistance of 13,910 ohms, a deflection of 250 mm. at a scale distance of one meter is obtained with a current of 31 microamperes; a heater having 18 ohms resistance required 800 microamperes to give the same deflection. To illustrate the high sensibility of this instrument, the author showed the large deflections produced by the currents through a telephone receiver even when the source of sound was many feet distant from the microphone. He also showed that if the thermogalvanometer was placed in series with the vertical receiver wire in spark telegraphy over a short distance, large reflections were produced. The third instrument described is a switchboard instrument which works on the same principle as the last, only that the moving part is pivoted in the usual way. He exhibited one of these instruments arranged to give the whole scale deflection for only 0.15 volt, which can be used in connection with shunts to measure large currents; for instance, to measure 1,000 amperes the power lost in the shunt would only be 150 watts. Transformers can also be used, as the power to produce the whole scale deflection is only 0.3 watt. A similar instrument with a high resistance heater was also exhibited, giving the whole scale deflection for 0.1 amp., which can be used as a voltmeter by putting resistance in series with it.—Lond. *Elec.*, May 20.

REFERENCE.

Induction Coils.—CODD.—The first part of an illustrated article in which the author discusses various details of induction coil design.—Lond. *Elec. Rev.*, May 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephony.—BENNETT.—A paper on corporation telephones in which the author gives a review of his work in this direction, together with a report of the extended discussion which followed the reading of the paper.—Lond. *Elec.*, April 22, May 20. An editorial with reference to this paper gives a comparison of telephone sys-

tems. Concerning the central battery system, it is said that its one doubtful feature is its complexity; numbers of relays have to be employed and the efficiency of the service depends to a large extent on the proper working of a chain of automatic devices. From remarks of Gill in the discussion it appears that no serious troubles arise from relay faults in practice. The writer thinks that there is much to say in favor of the simple magneto system with branching multiple switchboards, for exchanges of small and moderate size. Automatic calling and clearing introduces a considerable complication, but for some reason it has come to be regarded as an essential to modern exchange systems. Even Bennett considers it of such importance that he introduces into his simple "ring-through" system the automatic feature with the aid of a "passing contact" in the subscriber's instrument. Then comes the substitution of an incandescent lamp and a relay for the drop indicator, which is justified by the saving of space on the switchboard, and still more by the increased facility for supervision. After one has gone so far as to make provision for automatic calling and clearing and for lamp signals, very little more is required to make the system a complete central battery system, with central battery speaking, as well as central battery signaling. The writer thinks that for small exchanges these refinements are certainly not necessary, but a uniform system throughout is very desirable. The old principle that an endeavor should be made to lessen the operator's work by making the subscriber do part of the operating, as on a call-wire and ring-through system, has not been found to work out well in practice. The greatest drawback is with junction working, in case of a failure to ring off.—Lond. *Elec.*, May 20.

Alarm Bells Tuned to the Strength of Direct Current.—BAUMANN.—An illustrated description of various devices of this kind, which appear to be specially suitable for calling up only the one party desired out of a number of parties connected to the same telephone wire on a "party line." The simplest arrangement is shown in Fig. 2. The electromagnet, *a*, has two windings, *b* and *c*; *b* is connected

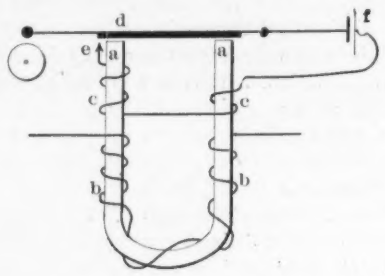


FIG. 2.—ALARM BELLS.

to the line while *c* is connected to a circuit containing a battery, *f*, and the armature, *d*, of the electromagnet as soon as the contact, *e*, is closed. The two windings, *b* and *c*, are so arranged that the magnetic fluxes due to them counteract each other. When a current of sufficient strength passes through *b* the armature, *d*, is attracted and the contact, *e*, is closed; then the magnetism is annihilated, due to the counteracting ampere-turns of *c*, and the armature is released. Then *b* acts again, and so on. The armature bears at its terminal a clapper which strikes the bell so that it will ring. No ringing of the bell will take place if the current through *b* is too small to attract the armature, *d*. On the other hand, in the case that the current is beyond a certain limit, the armature will be attracted by the current passing through *b*, but *c* will not be able to produce a sufficient counteracting magnetic flux and the armature will not be released. There will, therefore, be a single click, but no real ringing of the bell. If one connects four of such devices in series in the line and four more, identical to the first four, in such a way that the current passes through them in the opposite direction, it is possible to operate without difficulty eight bells in the same line with say 30, 60, 90 and 120 milliamperes. A considerable number of such devices is in use in German party lines for telephony. It is stated that the devices are not very sensitive against variations in the insulation of the line. One disadvantage of this device is that when, for instance, the one bell tuned to 120 milliamperes is set into action, the armatures of the others are also attracted and produce a click on the bell. While the bell does not ring, yet the click is a disadvantage. To prevent that another arrangement is used, the principle of which is shown in Fig. 3. The principal point is that each electromagnet has two armatures, *d* and *f*, which together form a contact. In Fig. 3 three such devices are connected in series, *c* representing the electromagnets, *h* batteries and *i* galvanometers. The springs, *e* and *g*, hold the armatures *d* and *f* in the position shown in the illustration. If a current of strength one passes through the line, it will attract in the first elec-

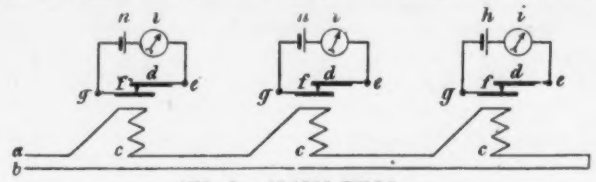


FIG. 3.—ALARM BELLS.

tromagnet the armature *f* and will disconnect *f* from *d*, but will not be sufficient to attract the armatures in the other devices. If a current of a greater strength 2 passes through the line, the armature, *f*, in the second device will be attracted and the contact between *d* and *f* will be broken. On the other hand, in the third device the current is not strong enough to attract *f*, while for the first device the current is so strong that both armatures, *f* and *d*,

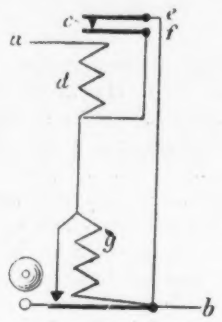


FIG. 4.—ALARM BELLS.

are attracted. Neither in the first nor in the third device the contacts between *d* and *f* are, therefore, broken so that only in the second device, which is tuned to the current sent through the line the contact between *d* and *f* is broken. This principle is applied as shown in Fig. 4. *a b* is the line, *d* is the electromagnet with a double armature mounted on the springs, *e* and *f*, and forming the contact *c*, while *g* is an electromagnet which when magnetized acts on a bell. If the current in *d* is too small the double armature, *e f*, remains unmoved and the current passes along the path *a d c e b*. If the current becomes sronger, the armature, *f*, is attracted and the current passes along *a d g b* and the bell rings. If the current is strong enough to attract both armatures, *e* and *f*, the current passes along *a c e* and *b*.—*Zeit. f. Elek.* (Vienna), May 15.

New Books.

ELEKTRO-AKUSTISCHE UNTERSUCHUNGEN. By Robert Hartmann-Kempf. Frankfurt: Gebruder Knauer. 255 pages, 105 illustrations.

This volume is remarkable as a book, for its clear type, good paper, careful proofreading and singularly beautiful photographic plate reproductions. It contains the results of the author's researches set forth as a doctorate thesis on the physical subject recited in the sub-title, namely, the influence of amplitude upon the pitch and decrement of tuning forks and tongue-shaped steel strips. The entire work bears the impression of careful experimenting and faithful recording.

A number of interesting physical data are developed from the experiments set forth in detail. The effect of the atmospheric pressure in lowering both the pitch and sustenance of both strip springs and tuning forks is abundantly evident. The change in pitch or frequency was in the neighborhood of one-tenth of one per cent. between full atmospheric pressure and a good vacuum, while the logarithmic decrement was reduced by the vacuum about three times.

The sharpness of the mechanical resonance to electromagnetic excitation was also well demonstrated. The application of this principle to the purpose of frequency measurement in the well-known apparatus of this type is immediately evident. The book will be of great value to the student of electromechanical resonance or of acoustics.

Electrical Interests in Panama.

The government of Panama has granted the United Fruit Company a fifteen-year concession for the operation of a system of wireless telegraphy between Panama, Colon, Bocas del Toro and the Bay of Limon and the Central and South American nations. The concession is now being discussed in the legislature, and will probably be approved.

The electric light and tramway plants and the telephone system in the Panama Canal zone have been bought by a syndicate, in which American capital is interested.

St. Louis Exhibits of the Westinghouse Companies.

The main service plant at the Louisiana Purchase Exposition, for which the Westinghouse Electric & Manufacturing Company received the general contract, is naturally a notable feature of the Westinghouse exhibits, and one which appeals, because of the commanding size of the four big electric generating units, each of 2,000-kw capacity, and their location in the central aisle of Machinery Hall, to practically all visitors to the Fair. These generators operate at a speed of 83½ r.p.m. and deliver 25-cycle, three-phase current at 6,600 volts. Entrance to the service plant exhibit is through a large 35-ft. plaster ring molded in close representation and in exact duplicate size of the stationary armature of the 5,000-kw alternating-current Westinghouse generators constructed for the elevated and subway train service in New York City. In this connection it may be said that 10,000-kw generators for the Ontario Power Company are now being constructed in the East Pittsburg works of the Westinghouse Electric & Manufacturing Company.

There is little in common in the Westinghouse Chicago service plant of 1893 and the St. Louis service plant of 1904, save the name of the manufacturer. At Chicago six of the twelve 750-kw generators there used were driven direct by Westinghouse-Columbina steeple engines, the other six being belt-driven to various types of engines, the space occupied by the smallest of the belt-driven generating units complete being about 65 by 27 ft. The units at St. Louis, almost three times as large, are direct-driven, of course, and the space occupied by each over all, with the 36-in. by 76-in. by 54-in. Westinghouse Corliss vertical cross-compound engines, is only about 35 by 15 ft., and 32½ ft. in height, the fly-wheels being 23 ft. in diameter.

The total space devoted to the service electric plant in Machinery Hall, with the exciter units, condensers, cooling towers and the 35-panel switchboard, is 26,260 sq. ft. The entire steam and electric station was designed and equipped by Westinghouse, Church, Kerr & Co., and all the motive power apparatus in connection with the generators, and in the steam generating plant in the nearby boiler house, was furnished by the Westinghouse Machine Company. The electric plant, although within the Westinghouse walls at the west end of Machinery Hall, has not been laid out on elaborate lines to combine the diverse characteristics of exhibition and service, and is an exhibit plant only in so far as it is representative of thoroughly modern practice at minimum cost. The various organizations associated with the Westinghouse name, which have united in representation at St. Louis under the title of the "Westinghouse Companies at Louisiana Purchase Exposition," have additional adjoining exhibit space in Machinery Hall of 26,260 sq. ft., space in the Palace of Electricity of 10,100 sq. ft., where Baldwin-Westinghouse electric trucks and locomotives also are shown, and space in the Palace of Transportation of 3,000 sq. ft., a total of 65,620 sq. ft., or nearly ten times the space occupied by the same interests at the Pan-American Exposition at Buffalo in 1901. The organizations associated in these joint exhibits, which represent an army of 30,000 employees, and occupy a total workshop floor space of over 140 acres, more than is found in all of the twelve great exhibition palaces of the St. Louis Exposition, are as follows:

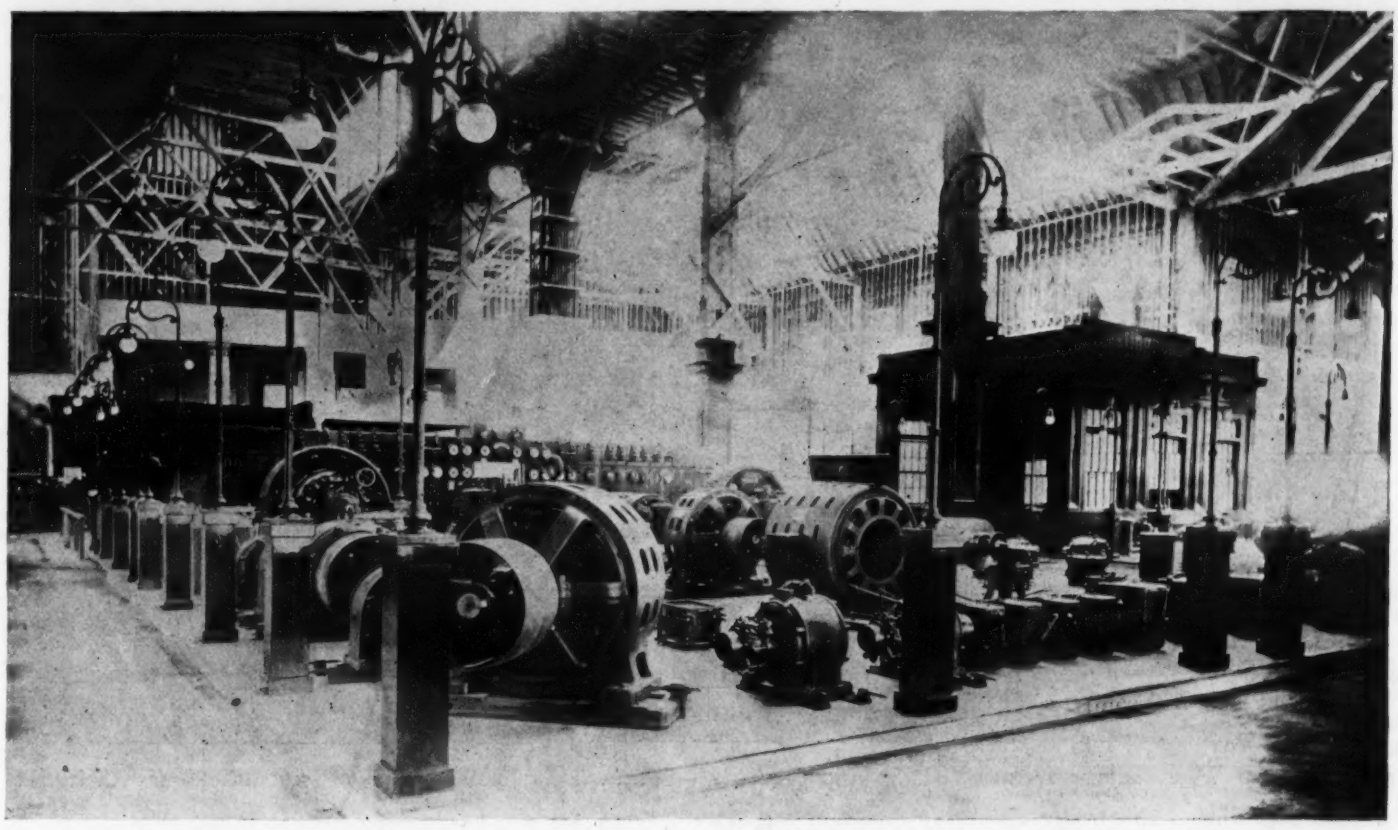


FIG. 1.—CORNER VIEW—PART OF WESTINGHOUSE ELECTRIC EXHIBIT, PALACE OF ELECTRICITY.

Westinghouse Electric & Manufacturing Company, Westinghouse Machine Company, Westinghouse Air Brake Company, Westinghouse, Church, Kerr & Co., Westinghouse Brake Company, Limited, London, Paris and Hanover; British Westinghouse Electric & Manufacturing Company, Limited, Westinghouse Automatic Air & Steam Coupler Company, Westinghouse Traction Brake Company, Canadian Westinghouse Company, Limited, Société Anonyme Westinghouse, Havre, France; Société Anonyme Westinghouse, St. Petersburg, Russia; Westinghouse Electricitäts-Actiengesellschaft, Berlin; Sawyer-Man Electric Company, Union Switch & Signal Company, American Brake Company, Nernst Lamp Company, Pittsburg Meter Company, R. D. Nuttall Company, Cooper Hewitt Electric Company, Bryant Electric Company, Perkins Electrical Switch Manufacturing Company.

In Machinery Hall, in addition to the electric service plant and the main exhibit of Westinghouse gas engines, turbo-generators, rotaries, exciters and motors in operation, all enclosed within ornamental staff walls and columned entrances of classic design, is the

Westinghouse auditorium, which seats 350 persons, in which are displayed at regular hours through the day the biograph and mutoscope pictures of scenes in and about the various Westinghouse works in the Pittsburg district, including the first interior photography of the kind ever taken by means of the Cooper Hewitt mercury vapor lamp. Through the courtesy of the companies, this auditorium, which is of ornate architectural design, rendered cool and comfortable at all times by a ventilating system which provides a continual supply of pure air and brilliantly lighted by the four principal systems of electric illumination, will be used throughout the Fair as a meeting place for scientific societies and technical congresses. The lighting of the hall is with the incandescent lamps of the Sawyer-Man Electric Company, Bremer arc lamps, Cooper Hewitt mercury vapor lamps and the Nernst glowers, all of which are used extensively throughout the Westinghouse display.

The Cooper Hewitt lamps, which made possible the Westinghouse mutoscope shop views, one of the distinct novelties of the Fair, are shown in the booths in Machinery Hall and in the Palace of Electricity, as designed for use in general illuminating, photographing and photo-engraving, with samples of work by some of the best operators in the latter lines. Demonstrations of the lamps will be given for the benefit of the National Photo-Engravers' Association at its June convention, and for the convention of the National Photographers' Association in October. The lamps are in use on the grounds by the official photographer, and in an illuminated sign of the Robbins Conveying Belt Company, in the Pike shows, "Over and Under the Sea" and the "German Tyrolean Alps"; and in various exhibits, and never fail to excite comment. The most striking use of the lamp, however, is in the eight-foot tubes which are hung over the entrance to the Westinghouse auditorium, and over the entrance to the Cooper Hewitt booth in the Palace of Electricity.

There are in all about 10,000 Nernst glowers in use in the exhibition buildings, 6,000 of them in the Fine Arts Museum, where they effectively solve the problem of artistic illumination. The handsome Illinois State Building is lighted by them, the National Cash Register Company uses the glowers in its three displays in the Liberal Arts, Electricity and Education Buildings, and the Westinghouse Companies use 300 big street glowers in their exhibits. Westinghouse generators are supplying current to the Nernst glowers throughout the Fair, as well as to the 200,000 incandescent lamps which outline the capitals, towers and general architectural design of the buildings in the charming night illumination. On exhibition or in service the Westinghouse Companies have installed within the Exposition grounds 14,000 hp in generating machinery and 30,000 hp in other apparatus.

The Sawyer-Man Company's display of various types and sizes of its well-known incandescent lamps is in the general Westinghouse exhibit space in the Palace of Electricity. There, also, the Bryant Electric Company shows a variety of lamp sockets, receptacles, switches and other products, including details manufactured by the Perkins Electrical Switch Manufacturing Company. The R. D. Nuttall Company's exhibit of cut and planed gears, trolleys, trolley gears and pinions, for electric railway, mine and industrial haulage motors, is in Machinery Hall, near the Westinghouse headquarters.

The Pittsburg Meter Company has a separate booth in block 35 of Machinery Hall. There the Keystone water meters and parts, with Westinghouse fish traps; Westinghouse gas meters, water meter provers, and a Westinghouse proportional 12-in. gas meter of the new straight-line type, with a capacity of 100,000 cu. ft. an hour, are shown. A graduated assortment of Keystone water meters on a revolving pyramid frame, with a 6-in. meter at the base and a ½-in. meter at the apex, constitutes the moving feature of the display.

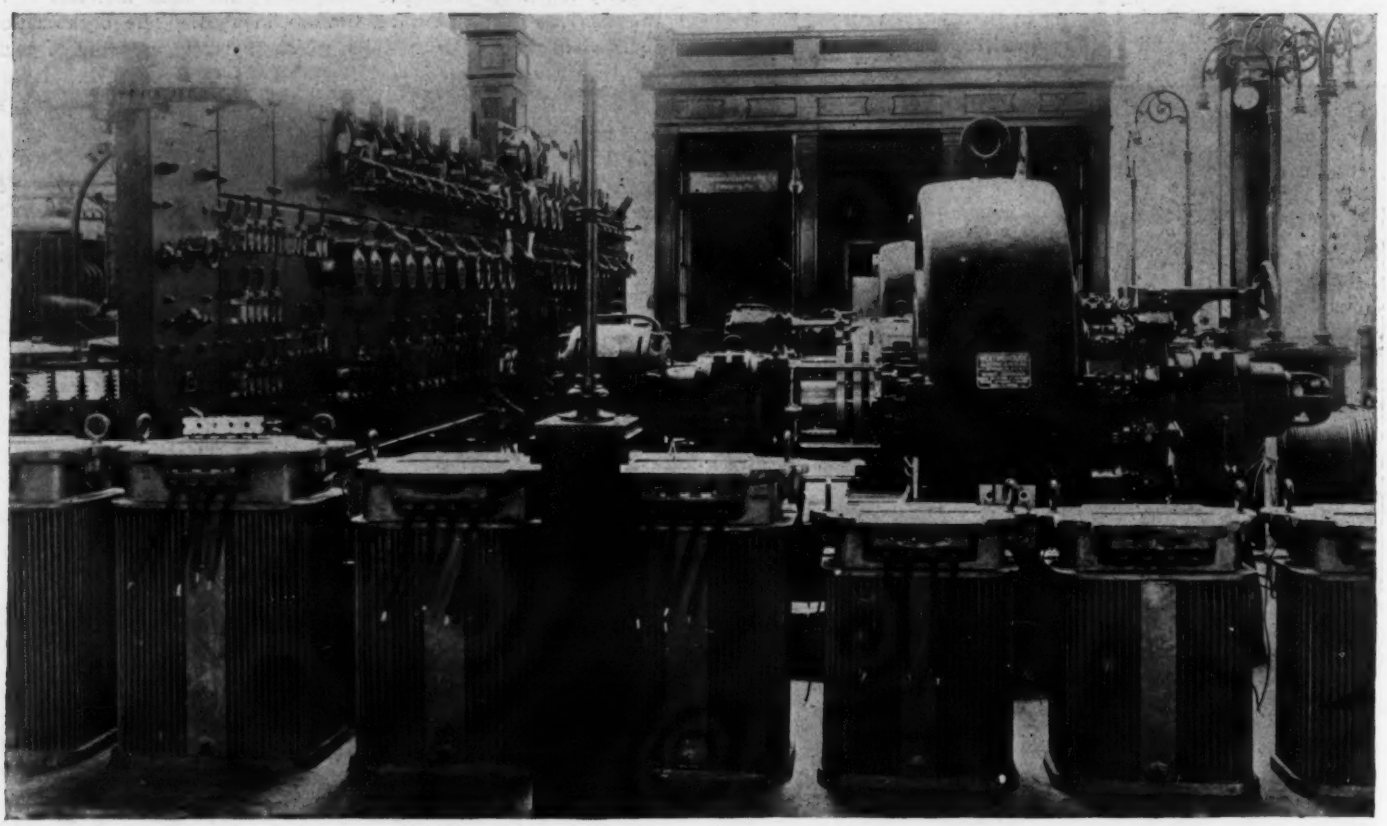


FIG. 2.—PART OF WESTINGHOUSE EXHIBIT, PALACE OF ELECTRICITY —SERVICE TRANSFORMERS, SWITCHBOARD AND ROTARY CONVERTERS.

Steam for the Westinghouse electric service plant is piped from the boiler house, known as the Steam and Fuels Building, nearby, in which there has been installed under the direction of the same engineers and contractors, a large battery of Babcock & Wilcox water tube boilers built into a single setting, with a total capacity of 6,400 hp. Equipment here includes also Roney mechanical stokers at the furnaces, operated by Westinghouse standard steam engines, a complete coal-conveying system furnished by the Link Belt Engineering Company, Cochrane feed water heaters, Worthington steam pumps, mechanical draft condensers, cooling towers and other apparatus to be found in a model station of the present day. The auxiliary apparatus in the electric plant includes three 80-kw, direct-current, 125-volt, direct-connected engine-driven exciter units, two of which are sufficient to operate the entire plant and adjacent auxiliary machinery in the exhibit sections. Each of the four chief generating units receives steam from a separate line, supplied by a separate battery, the entire plant thus consisting of two sections which may be operated independently or together.

The exhibit service plant, immediately west of the companies' headquarters, is utilized to furnish power for various purposes, and includes a Westinghouse-Parsons steam turbine generating set of 400-kw capacity, operating at a speed of 3,600 r.p.m., and delivering three-phase, 60-cycle currents at a potential of 440 volts. The unit selected for exhibit is of a size that has met with most extended

introduction by reason of its applicability to power stations of moderate size, and at the present time is the smallest turbine unit built by the Westinghouse Machine Company, a number now nearing completion being of 7,500-hp capacity. The construction of the rotating field of the generator shown in connection with the turbine on exhibition may best be studied in the Westinghouse exhibit in the Palace of Electricity, where one of similar type is set up, but not in operation. The exhibit service plant contains also a 125-hp vertical and a 225-hp horizontal gas engine, the first direct-connected to standard two-wire, the second to standard three-wire, double-voltage, direct-current generators. Both single-acting and double-acting types of gas engines at present manufactured by the Westinghouse Machine Company are here represented in their latest form. The horizontal engine may be regarded as strictly representative of the modern internal combustion motor in its most recent development. Here, again, the gas engine unit on exhibition is one of the smallest built in its particular type, engines up to 3,000 hp now being under construction in the Westinghouse shops.

An important part of the Westinghouse installation which is seen by few is the pumping apparatus under the beautiful Cascades in front of Festival Hall. This equipment was designed to supply 90,000 gallons of water a minute for these Cascades, by three large centrifugal pumps each driven by a 2,000-hp Westinghouse induction motor, probably the largest motors ever constructed. The famous "Jumbo" engine which alone operated all the machinery of the Philadelphia Centennial Exposition in 1876, was rated at 1,000 hp. Here,

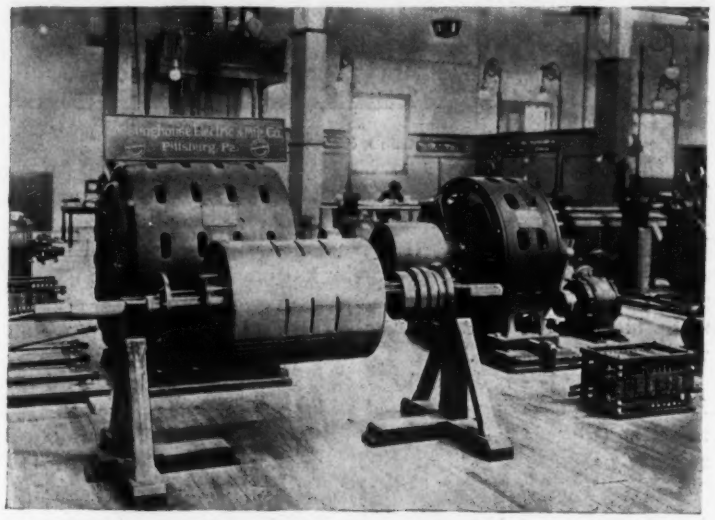


FIG. 3.—REVOLVING FIELD AND STATIONARY ARMATURE OF TURBO-GENERATOR SET, PALACE OF ELECTRICITY.

in a single plant, operating but one feature of the St. Louis Fair, is machinery with six times that capacity.

In the Palace of Electricity the Westinghouse Electric & Manufacturing Company occupies a space of over 10,000 sq. ft., including 1,600 sq. ft. devoted to the display of electric trucks and locomotives constructed in conjunction with the Baldwin Locomotive Works. Two locomotives built for mine service are shown, one weighing 20,000 and the other 30,000 pounds, each equipped with two No. 79 motors at 500 volts. Another 20,000-pound locomotive, for switching, is equipped with two No. 75 motors at 220 volts. In the regular electrical equipment display are a 400-kw turbine type generator, typical generators for direct and alternating currents, for belt or direct connection; rotary converters, motor-generator sets, oil-insulated and air-blast transformers, direct-current and alternating-current railway motors and controllers, single and polyphase induction motors of constant and variable speeds, direct-current motors of many types, including motors for variable-speed service from single and double-voltage circuits, switchboard apparatus, ammeters, voltmeters, wattmeters, synchroscopes, power factor meters, circuit-breakers and switches, many of them electrically operated; portable instruments, instruments of precision, potential regulators, and innumerable other forms of auxiliary apparatus and instruments. The alternating-current, series-wound, single-phase crane motors, similar in type and general construction to the single-phase railway motors exhibited in the Transportation Building, and the new "Westinghouse Unit Switch System of Multiple Control" are also to be seen in this section. The spectacular high-tension sign, using a potential of 50,000 volts, which spells the name "Westinghouse" in lightning-like discharges radiating from large letters over a plate glass surface—one of the attractions at the Pan-American Exposition—is to be seen in the Westinghouse auditorium.

The combined exhibit of the various Westinghouse brake companies extends for 150 ft. down the aisle from the turn table in the Transportation Building. At the end nearest the turn table is a reception room for guests, and at the other end is a booth fitted up

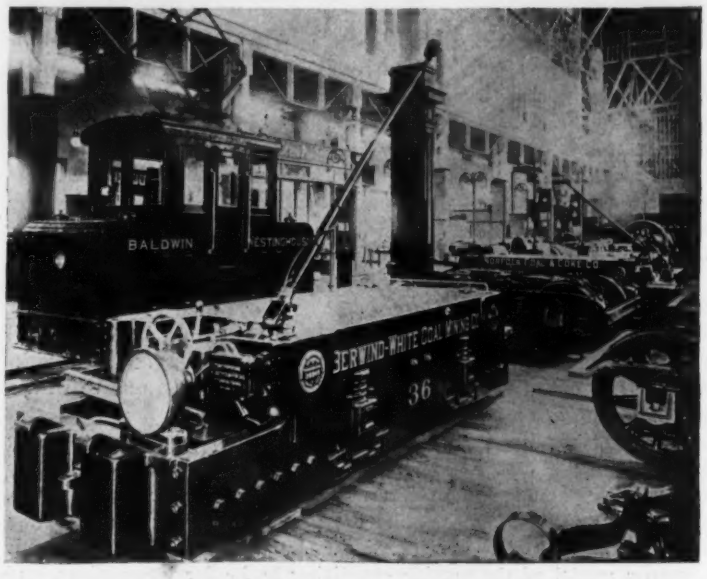


FIG. 4.—BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVES, PALACE OF ELECTRICITY.

as a Russian kiosk by the Westinghouse Company, Limited, of St. Petersburg, to be used as a rendezvous for Russian visitors to the Fair. Included in this operating exhibit is the display of the Westinghouse Electric & Manufacturing Company's alternating-current, single-phase railway motors, now so prominently before the engineering world, and which are introducing radical changes in present railway practice.

The Westinghouse Air Brake Company's exhibit shows a rack made up of apparatus constituting the equipment for a six-coach passenger train with engine and tender, all fitted throughout with the high-speed brake and signal equipment. The engine and tender are equipped also with the combination automatic and straight air

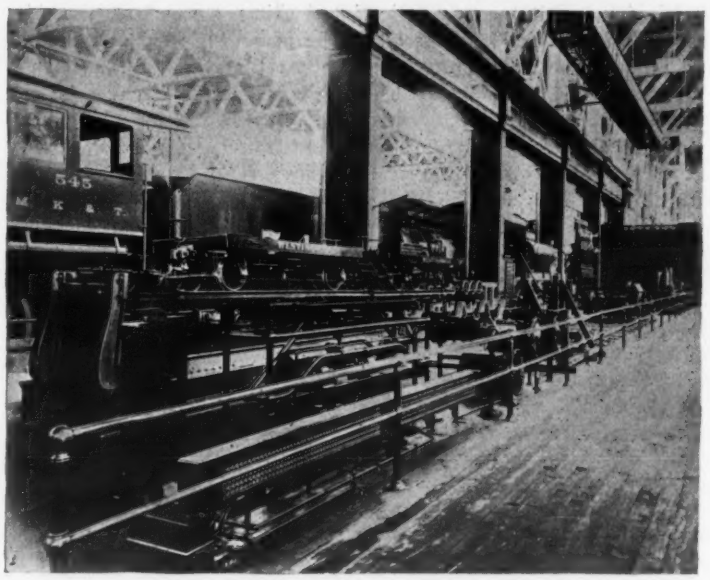


FIG. 5.—BRAKE EXHIBITS, TRANSPORTATION BUILDING.

brake which is now so much in use. The method at present generally adopted when two pumps are used on one locomotive is shown, and one of the novel features of the rack is that all valves are placed in duplicate, one sectioned so as to show the internal working mechanism, and connected to the valve in use in such a

manner that it moves as the regular valve is operated. The operation of the various valves is thus readily studied.

The Westinghouse friction draft gear also is shown in section, with a machine especially designed for testing it in operation. The available power which can be exerted on the draft gear approximates 2,000 pounds. A triple valve testing rack is presented to show the manner in which this device is now being installed in many railroad shops. Sectional parts also are shown of the other apparatus of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company. The latter's exhibit consists of the magnetic brake and car-heating apparatus and the straight air brake for both motor-driven and axle-driven compressors. The magnetic brake is applied to a truck operated on a track 45 ft. long, the truck being equipped on both ends with friction draft gear buffers, showing the use of this device which has become extensively adapted to this kind of service. In this connection also is shown the separate brake controller for use with the magnetic brake when it is decided to add the latter to street railway equipment having the ordinary controller for the motor.

The straight air brake rack shows the equipment now used in the straight air outfit on electric cars that are operated by one of their standard compressors. The compressors shown are of the axle and motor-driven types, in section for inspection of their internal working parts. One of the sectional compressors is fitted to move with a regular compressor in operation.

Swinging picture frames are hung from a pipe frame to show photographs and colored instruction charts which adequately portray the equipment made by the Westinghouse Traction Brake Company, the colors representing the different pressures during the operation of the brake. In the exhibit of the American Brake Company is shown a model of the outside equalizing brake for locomotives, and the American automatic slack adjuster. The Westinghouse Automatic Air & Steam Coupler Company shows the ends of two freight cars fitted as movable models to show the operation of the device in actual practice. This also is shown on two small models fitted with air and steam and signal coupler. Under this model is another working model of the magnetic brake, arranged to show the operation of the device.

The Union Switch & Signal Company's exhibit is a group of signals, full size and in working condition, erected in the Transportation Building. The company shows also examples of electrical apparatus for the operation and control of signals, photographs of various installations, and a signal designed for use in the tunnels of the Pennsylvania Railroad under the Hudson River to New York City shown in position in a full-size model of one of the tunnel tubes. The company's most important exhibit at St. Louis, however, is in installations in actual service, including the Westinghouse electro-pneumatic interlocking system at the big union station, which controls all of the passenger yard movements, and is much the largest interlocking apparatus ever built.

A brief guide pamphlet to the Westinghouse exhibits may be secured at the headquarters and exhibits office, in the form of a neat folder which includes maps of St. Louis and the Exposition, and a list of typical Westinghouse installations in St. Louis. Red lines on the St. Louis map show street railways using Westinghouse apparatus. In the city of St. Louis to carry the visitor to the Fair grounds, are 1,000 street cars equipped with Westinghouse air brakes, driven by Westinghouse motors, and operated from stations in which are installed Westinghouse generators with a total capacity of 20,000 hp.

A Two-Belt Conveyor System.

We do not know whether any figures exist showing how much material is now conveyed by belt, motor-driven or otherwise, but in the aggregate the quantities must be enormous, and they would probably keep a fine steam railroad very busy. This field of work is inviting to inventive genius, and it has seen some remarkable improvements and developments. We now illustrate and describe a system that has just been introduced by which a great advance in the art is said to have been made. We refer to the two-belt conveyor system designed by the Ridgway Belt Conveying Company, of New York, in which an interior troughing and supporting belt runs over its individual head and tail pulleys, having separate take-ups, and is entirely independent of the conveying belt proper. The conveying belt is threaded over its head and tail pulleys in the usual manner, and has its separate take-up, so that the two belts, although moving together in the same direction at the same speed, are entirely separate and distinct. This enables the conveying belt to be lifted off the supporting belt and out of the troughing blocks and passed through either a stationary dumper or a moving tripper.

The conveying belt has no work put upon it other than that required to drive the lower carriers and its own head and tail pulleys, all the carriers on the upper line, which comprise two-thirds of the total number used, being revolved by the inner supporting belt.

FIG. 1.—CARRIERS USED IN TWO-BELT CONVEYOR.

The strains, therefore, are divided, the belt revolving two-thirds of the moving parts not being subject to the wear and tear of carrying the load, and the belt carrying the load being relieved of the strains and wear and tear of revolving the greater part of the moving parts of the machine. This produces a divided labor in wear and tear which enables both belts combined only to represent in strength what would be required of one belt in any one-belt system.

The interior belt is driven by a roller or block chain sprocket drive from the main driving shaft, and with the two belts in tension just sufficient to prevent slip on their driving pulleys; both belts move at exactly the same speed in the same direction, and there is no rub

FIG. 2.—INTERIOR TROUGHING AND CARRYING BELT.

of the conveying belt on the troughing blocks. At the points where the conveying belt meets the interior supporting belt, to prevent the rub and wear caused by the troughing blocks moving in a larger radius (the conveying belt being at the same height as the center of the supporting belt) a pair of concentrating rolls lifts the edge of the belt and drops it into the troughing blocks. The same method is used where the conveying belt leaves the troughing blocks at the opposite end.

Fig. 1 shows the carriers used in the two-belt system. They are straight rollers fastened to steel shafts revolving in babbitted boxes, the boxes being ball and socket, ring-oiling, felt-washered

and dust-proof. In the two-belt system the conveying belt proper lies in a natural position, a true segment of a circle, with the strains distributed over its whole width uniformly. This increases the life of the belt from 75 per cent. to 100 per cent. over any type of pulley troughing belt. In Fig. 2 is seen the interior troughing and carrying belt with its troughing blocks attached. This interior belt, by a compensating drive, is driven at the same speed as the upper carrying belt, and the two move together through their entire travel on both the upper and lower sides. The conveyor belt proper for the two-belt system is a machine-made belt with a protective cover of average good material. The special belts, which are made to conform to the hard conditions of continuous flexing, are hand-made belts, and to give satisfactory service must be made of the highest grade of material to stand the wear and tear of angular bending.

The inner or troughing belt carries the outer or conveying belt through the upper line of working travel and the outer belt carries the inner belt on its return and through its travel in the lower line. The ability to use straight rollers, all strains being compression strains and not bending or breaking strains, enables the use of the lightest castings that can be machined and finished. This reduces the weight, cost and power required. Only a clean belt comes in contact with the upper carriers, which comprise two-thirds of the total number used. When the conveying belt proper, the only one necessary to be renewed, gives out, the cost of its renewal is stated to be approximately one-half in the two-belt system of what similar material would cost in any type of single belt conveyor. This system has, we are informed, already been put into successful use. Its application to light, power and railway plants is obvious.

A New Three-Point Auto-Starter.

The necessity for gradually applying to a motor the full line voltage of the circuit to which it is connected, in order that the starting torque may be developed by degrees and the starting current reduced, has given rise to a number of appliances suited to the different kinds of service and especially adapted to the motors with which they are to be used. One of such devices, known as the Westinghouse oil-immersed auto-starter, designed for use with Westinghouse type C induction motors, is shown in the accompanying illustration. It is used for motors of 5 to 50 hp; smaller motors of this type being started by closing the circuit with an ordinary switch, and starting

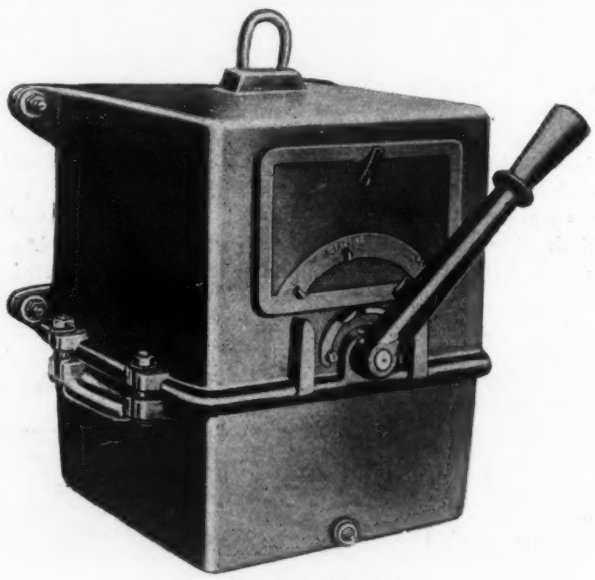


FIG. 1.—AUTO-STARTER.

controllers of another type being used for motors larger than 50 hp.

In effect, the auto-starter described consists of an oil-submerged drum switch used in connection with a pair of auto-transformers which have loops so arranged that a choice of two of several starting voltages is given. It thus combines the functions of a line switch in opening and closing the circuit with those of a controller or starting rheostat with two reduced starting voltages.

The switch, which is of the horizontal drum type, is placed in the oil tank with all live parts submerged, the handle and drum being so connected by gearing that the handle shaft is brought out above the level of the oil. In the style used with 5 to 15-hp motors, the switch is a simple drum on which the fingers bear directly, but in the 20 to 50-hp sizes, which carry larger currents, blades on the drums slide through jaws, giving superior contact. The drum contacts and contact fingers can be easily renewed, and if desired the entire drum can be detached. The absence of flexible leads is of advantage here, as it facilitates the removal of the drum and insures durability.

The drum is so arranged that the movement of the handle is progressive, passing in succession from the off position through the two starting notches to the running position. There is no possibility of moving the handle directly to the running position without first applying the starting voltages, as is frequently done by mistake when

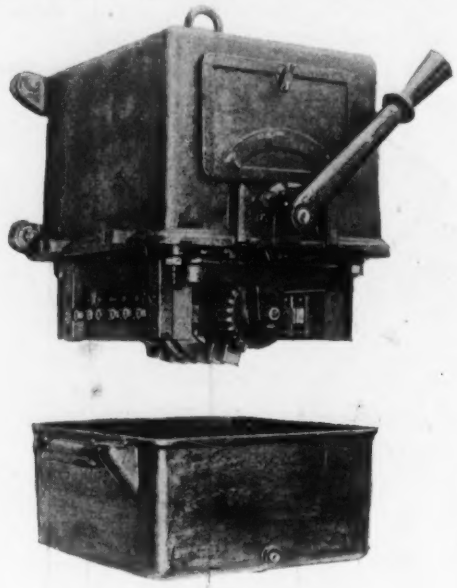


FIG. 2.—AUTO-STARTER.

the off position is placed between the starting and running positions and the handle is thrown first in one direction and then in the other. Nor is the operator so liable to leave the handle in a starting position and ruin the auto-starter by overheating the transformer. The handle is usually placed as shown, but if desired it can be reversed, so that the hand moves below the shaft.

The connections between the drum switch and the auto-transformers are arranged to give the best starting voltages and are adjustable, to suit the conditions of service. Each of the transformers has five taps, giving respectively 30, 40, 50, 60 and 85 per cent. of the full line voltage, and by changing the connections between the transformers, the starting voltage can be changed to give the torque desired. When the handle is in the running position connection is made directly between the motor and the line, the transformer being cut out. When the handle is in the off position both the transformer and motor leads are disconnected, the only live parts being the leads from the generator, a fact of distinct advantage when it is desired to change the transformer connections.

Changing the connections is also facilitated by bringing the transformer taps to the front of the case, where they can be readily reached by removing the hand-hole cover shown in the illustration.

It will be noted that especial attention has been paid throughout to convenience and adaptability to different conditions. In addition to the features mentioned, there are a number of others in which the convenience to the user has been consulted. Access to the drum is facilitated by slotting the lugs through which the bolts pass, so that when the nuts are loosened the bolts can be withdrawn sidewise and the tank lowered. The proper oil level is distinctly marked and drainage and filling tubes are conveniently located. The tank is tightly fitted to the upper portion of the case, and by providing the main hole cover with an air-tight gasket the interior can be protected against acid fumes or dangerous gases. This feature, together with the submersion of all live parts in oil, makes it possible to use the auto-starter where there are inflammable gases or combustible floating particles in the air. As a precautionary measure, the handle is locked in each of the four positions, being released by a pressure upon a button on the end of the handle, this provision preventing a too sudden starting of the motor. The fact that the auto-starter may be placed at any distance from the motor is also an advantage, when motors are suspended from ceilings or placed in other convenient locations.

Thermometer-Thermostat.

The Bristol Company, of Waterbury, Conn., is placing a new instrument upon the market to which has been given the compound name above, since it is a combination thermometer and thermostat. The instrument will give correct indications of the temperature of the atmosphere, gases or liquids at all times, and also serve as a thermostat to make electric connection at any predetermined limits of temperature for the purpose of operating controlling apparatus, alarms and the like.

Fig. 1 shows an external view of the instrument, which is provided with a six-in. scale graduated in degrees Fahrenheit. The construction and capabilities of this instrument will be best understood by referring to the interior view, Fig. 2, in which *A* is an arm

FIG. 1.—THERMOMETER-THERMOSTAT.

pivoted at lower portion of the case, terminating in a point resting on the arc of the graduated scale, and is held by friction at whatever point it may happen to be set. Two adjustable contact pieces, *B* and *C*, are carried by this arm. These contact pieces are capable of adjustment by means of a screw, *D*, which is threaded so as to cause the contact pieces *B* and *C* to approach or recede at equal rates and distance from the center line of the arm, *A*, upon which they are supported. They are also connected to binding posts, as shown, which are used for making outside connections. These binding posts are located within the case to avoid any possibility of the wires or connections being disturbed without detection. Three holes with insulating eyelets are provided in the lower portion of the case, as shown, for the insertion of connecting wires. The high and low contacts can be placed on a single or on independent circuits. The arm, *E*, moving over the graduated scale, indicates the changes of

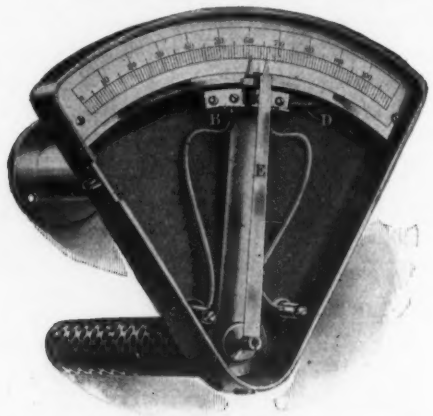


FIG. 2.—INTERIOR VIEW OF THERMOMETER-THERMOSTAT.

temperature where the instrument is located. This arm is operated by one of Bristol's recording thermometer tubes placed in the perforated protecting projection extending from the back of the case, as shown in the illustration. On the back of the indicating pointer, *E*, there is a raised portion which makes electric connection with the contact pieces.

A novel feature of the instrument is that the temperature indicating arm *E* is not restrained by the thermometer-thermostatic contacts. Thus it will be seen that the controlling effect of the thermostat is perfectly adjustable as to position on the scale of the thermometer, and also as to high and low limits of operation, without in any way interfering with the correct indications of the thermometer in case the temperature does not remain, or is not controlled, within the limits for which contact pieces may be set.

The instrument may be readily applied to liquids, as for instance to indicate the temperature and set into operation controlling apparatus for the brine in a refrigerating system or tank.

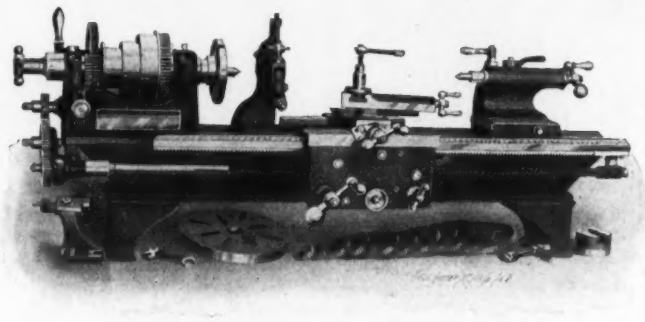
For temperatures above the atmosphere, as that occurring in ovens, kilns, closed spaces, or of liquids in pipes under pressure, a small bulb is located within the closed space or pipe. This bulb is connected with the thermometer-thermostat by a capillary tube filled with alcohol. The temperature at the bulb is communicated to the instrument, which may be located at any convenient point for observation. The electric wires connecting with the adjustable thermostatic contacts may be carried to any point where the controlling apparatus may be located or where it is desired that an alarm shall be given.

New Screw-Cutting Bench Lathe.

There is said to be a growing demand for an accurate and reliable bench lathe than can be bought at a moderate price and at the same time is a complete screw-cutting engine lathe, suitable for laboratory, electrical, optical and experimental work; tool, model scientific instrument making, etc.—in short, for profitable use in all lines of fine, accurate manufacturing and precision service. The "Star Special" screw-cutting bench lathe shown by the accompanying half-tone has been built to supply this demand. The head stock has a large hollow spindle, made from a crucible steel forging, with draw-in chuck for split collets up to ½ in. capacity, and phosphor-bronze boxes with improved end-thrust ball bearings. The cone pulley has three steps for wide belt and with strong back gears gives six changes of speed. A push pin on the head gear allows the cone to be instantly locked or unlocked without using a wrench. The tail stock is the curved or cut-under pattern, which allows the compound rest to swing around parallel with the ways and over the base of the tail stock with room to operate the feed screw handle. The spindle has an improved locking device, and the tail stock is provided with side adjusting screws for turning tapers. There is a long bearing on the bed and it is locked in such a manner as to render it firm and rigid.

The carriage has a long bearing on the ways and is gibbed to the bed both front and rear. A cam-locking device locks the carriage to the bed when using the cross feed. The cross feed screw has a graduated collar which reads in thousandths of an inch and can be set at zero in any position. Plain and compound rests are regularly furnished and easily interchanged. The base is graduated 180° and renders the compound rest capable of fine adjustment. The tool post has a patented collar and shoe which exclude all dirt and chips and admit of quick, easy and secure adjustment of the tool.

The automatic cross and longitudinal feeds are actuated by a



SCREW-CUTTING BENCH LATHE.

phosphor-bronze worm on the lead screw, receiving its power from the head spindle through spur gears. The lead screw is splined and simply acts as a feed rod, hence the only wear on the threads is in screw-cutting. The automatic feeds are almost indispensable for a large variety of work, as they secure more accurate and smoother surfaces. The range of feeds is very large. The range for screw-cutting is extra large, cutting all standard threads, right or left (including 11½ in. and 27 in.), from 3 to 64 without compounding the gears and nearly all threads by compounding. Patented spring nuts are used in connection with split washers to hold the change

gears in place. They are easy and convenient to operate and allow quick shifts of the change gears.

The bed is 46 in. long, broad, deep, thoroughly well braced and accurately proportioned throughout. The rated swing is 9 in., but it has an actual swing of 10⅓ in. over bed and 24 in. between centers. The countershaft has friction clutch pulleys easy to operate, strong and durable, and self-aligning and self-oiling shaft bearings. The pulleys and friction bands are provided with self-closing oil cups.

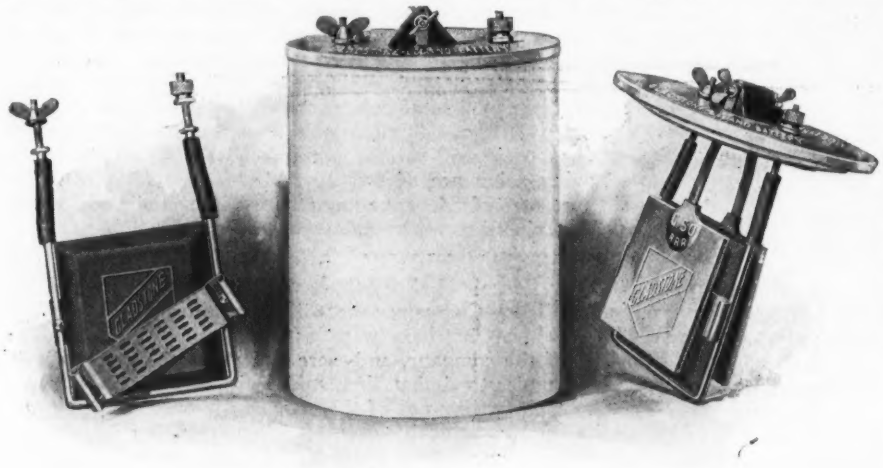
The "Star Special" screw-cutting bench lathe is made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y., makers of the well-known foot and power "Star" lathes.

The Gladstone-Lalande Primary Battery.

The battery shown in the accompanying illustration is an improvement on the type of battery invented by De Lalande & Chaperon, of which there are several modifications on the market at the present time. In the Gladstone-Lalande battery the negative electrode is composed of a plate of agglomerated oxide of copper, having its surfaces reduced to the metallic state. This copper oxide plate is carried in a supporting hanger, made of copper rod formed into a U-shaped frame, the two free ends of which are threaded to receive clamping nuts, by which it is fastened to the porcelain cover of the battery. This supporting hanger is provided with two perforated flat spring copper clamps, attached to the opposite sides of the hanger. One of these spring clamps is riveted at each end to the hanger, and the other is detachable, having slotted eyelet holes at each end which fit over the two rivet heads on the sides of the hanger; the clamp is locked in position by being pulled slightly in a downward direction. The copper oxide plate is so placed in the hanger that one of its flat surfaces bears against the fixed spring clamp. The detachable spring clamp is then locked to the hanger, as described above, so that it bears against the other flat surface of the oxide plate, which is held firmly between the two spring clamps.

The advantages possessed by this form of construction are that when the battery needs to be recharged the exhausted oxide of copper plate can be removed from the hanger and a new one substituted with the least possible loss of time, and without soiling the fingers. The wide surfaces of contact presented by the perforated spring clamps render it unnecessary for any cleaning or sandpapering of these parts when recharging the battery.

The positive electrode consists in all cases of two flat plates, composed of an alloy of zinc and mercury, which are suspended from the cover. In some models these flat zinc plates are cast on an inverted U-shaped hanger, having a threaded extension which passes through a hole in the cover, to which it is clamped by a suitable nut. In other models (as shown in the illustration) the two zinc plates



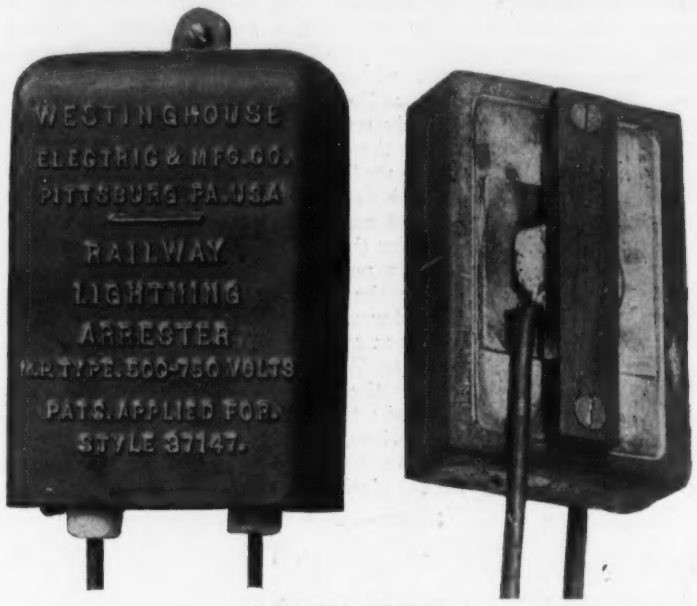
PRIMARY BATTERY.

are cast on separate stems, having a hole at the upper extremity which allows them to be bolted to the projecting knob on the top of the cover, which is provided with a horizontal hole to receive a threaded bolt for this purpose.

The electrolyte in all cases is a 20 per cent. solution of pure caustic soda, and a layer of pure mineral oil is poured on the top of solution to prevent evaporation and creeping. These batteries are manufactured by the Battery Supplies Company, Avon Avenue and Jelliff Avenue, Newark, N. J., the proprietor of which, Mr. J. W. Gladstone, is the inventor.

Multipath Lightning Arrester.

During his extended investigations of static phenomena and the protection of apparatus from lightning discharges, it became evident to Mr. P. H. Thomas that to successfully protect apparatus operated on low-voltage circuits, such for example as railway motors and generators, it would be necessary to produce an arrester which would offer a much easier and more open discharge path to earth than could be found in any arrester previously devised. To protect the arrester from damage, due to the line voltage holding over, was also an essential requirement. As the result of experiments carried



LIGHTNING ARRESTER.

on continuously for several years, both in the laboratory and under actual service conditions, the Westinghouse Electric & Manufacturing Company has placed on the market a new type of lightning arrester, devised along the lines of two general principles, as follows:

1. There is a minimum voltage, below which an arc cannot be maintained across an air-gap, no matter how small that gap may be. 2. Under proper conditions a static discharge will distribute itself over a great number of parallel paths, so that the amount passing over any one path will be very small, producing practically no heating or disintegrating effect. From this second principle the arrester takes its name, multipath (M.P.).

The arrester consists essentially of a specially prepared block of carbon, in which the area offered for discharges is very great as compared to the length of path through which the discharges pass. In this block there are a great number of separate conducting paths, and the discharge passing through the block divides and takes simultaneously many different ones. Each of these paths is broken up by a large number of minute air-gaps, so that the voltage across each gap is very small and the line voltage cannot maintain an arc across them. Thus the arrester is non-arcing, since the line current does not follow the static discharge.

In series with the carbon is a small air-gap rigidly maintained between two metal surfaces. This air-gap keeps the arrester insulated from the line, except at the instant of a discharge. The active parts of the arrester are enclosed in a cast-iron box which is filled with a water-proof compound.

The arrester is weather-proof and fire-proof. It may be used indoors or outdoors and may be located in practically any position desired. Its weight is from ⅓ to ½ that of any other arrester on the market, it is small and compact and has absolutely no moving parts to stick and get out of order. Some of the advantages claimed for the new type of arrester are as follows:

1. Great protective power (low resistance to static discharges). 2. Non-arcing. 3. No moving parts. 4. Fire-proof construction. 5. Light weight. 6. Neat appearance and ease of installation. 7. Simplicity and compactness.

Of the illustrations, the one on the left hand shows the lightning arrester complete, and that on the right shows the interior of it.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was exceedingly dull and lifeless. The public is doing nothing, and the operations by professional traders are conducted on a restricted scale. The uncertainty as to the crop situation and the coming political campaign are the supposed principal causes of the lack of interest and inactivity. The decreased railroad earnings did not seem to affect perceptibly the standard railroad stocks, although some little pressure developed in some of the minor railroad specialties. Steel issues were also under some pressure owing to the adverse accounts of the iron industry, although some remarkable prophecies are to be noted as to the enormous business to be done in 1905-6. Preferred declined somewhat, but easily recovered at the end of the week., Brooklyn Rapid Transit was sensitive to further talk regarding increased traffic and earnings. There was a fairly brisk trade in this stock, the sales for the week aggregating 27,670 shares, the closing price being 47⅛, a net gain of ⅜ point. Metropolitan Street Railway closed at 110, the sales amounting to 5,800 shares. General Electric was quiet and weak, only 600 shares having changed hands, at prices ranging between 155 and 156, the closing price being 155 and a net loss of 1 point. Westinghouse closed at 156⅛, and thus gained ⅛ point net. In the telegraph group Bell Telephone lost 1⅛ points, closing at 125¼; Western Union closed at 86¼, this being a loss of ¾, and American Telegraph and Cable gained ¾, closing at 88. There were no features in the curb market, which was quiet. Following are the closing quotations of June 7:

NEW YORK.

	May31	June 7		May31	June 7
Allis-Chalmers Co.	7⅛	7⅛	Electric Vehicle	6⅞	7¼
Allis-Chalmers Co. pfd.	40	40	Electric Vehicle pfd.	9¼	10¼
American Tel. & Cable	86¾	86	General Electric	155¼	155
American Tel. & Tel.	125	125	Hudson River Tel.		
American Dist. Tel	22	22	Metropolitan St. Ry.	109½	110⅜
Brooklyn Rapid Transit	46⅞	47	N. Y. & N. J. Tel.	..	..
Commercial Cable	180	180	Marconi Tel.	..	..
Electric Boat	25	25	Western Union Tel.	85¾	86¼
Electric Boat pfd	60	66	Westinghouse com.	154⅛	154
Electric Lead Reduction	9⅛	*⅜	Westinghouse pfd.	180	180

BOSTON.

	May31	June 7		May31	June 7
American Tel. & Tel	125	125	Western Tel. & Tel. pfd.	77	77
Cumberland Telephone	112¾	112	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	234	*235	New England Telephone	121	118
General Electric	154	155	Mass. Elec. Ry.	18	18¼
Western Tel. & Tel	..	*72	Mass. Elec. Ry. pfd.	72	..

PHILADELPHIA.

	May31	June 7		May31	June 7
American Railways	44	43	Phila. Traction	95¾	96
Elec. Storage Battery	55	55	Phila. Electric	5⅛	6⅜
Elec. Storage Battery pfd.	55	55	Phila. Rapid Trans.	12¼	12¼
Elec. Co. of America.	8⅛	8¼			

CHICAGO

	May31	June 7		May31	June
Central Union Tel	..	..	National Carbon pfd.	101¾	101
Chicago Edison	..	144	Metropolitan Elev. com.	18	21
Chicago City Ry.	165	170	Union Traction	6	*8¾
Chicago Tel. Co.	..	118	Union Traction pfd.	29	28
National Carbon	20	26¼			

*Asked

BELL TELEPHONE AND CENSUS.—The recently published census figures on the telephone industry have created much comment in telephone circles in Boston, as they constitute practically the first intelligent effort to secure authentic statistical information regarding this important industry. An official of the American Telephone and Telegraph Company is quoted as saying: "The Government deserves much credit for the figures prepared by the census bureau regarding the telephone. While they were not strictly accurate in all particulars, the figures were as nearly correct as could be secured. The census figures showing 5,000,000,000 telephone 'talks' during 1902 must be accepted with a grain of salt. While the Bell system of recording such figures is as nearly perfect as human ingenuity can make it, our records are likely to be 3 per cent. to 5 per cent. out of the way. We figure that the Bell 'talks' during 1902 were 3,000,000,000, which, according to the census figures, would leave over 2,000,000,000 'talks' for the independents. These latter figures are too large. With the Bell telephones outstanding numbering 1,575,160 (in 1902), there were left for the independents about 750,000. It is absurd to credit the independents with two-thirds as many 'talks' as the Bell companies when we had twice as many telephones outstanding. The statement that the independent companies now have a larger number of telephones outstanding than the Bell companies is incorrect. I do not believe the ratio to-day is more in favor of the independents than it was in 1902, and I have reason to believe that the percentage is steadily increasing in favor of the Bell companies."

NEW ENGLAND TELEPHONE.—The annual report of the New England Telephone Company for last year, already noted in this column, showed share earnings of $1,415,139, equal to 0.5 per cent. on the $21,616,700 capital stock outstanding at the close of the year. As compared with 1903, gross earnings increased $668,255, or 11 per cent.; operating expenses increased $421,884, or 8½ per cent.; and net earnings increased $246,370, or 21 per cent. The percentage of operating expenses to gross earnings was as follows: Gross earnings $6,692,864; operating expenses, $5,277,295; per cent. of expenses to gross earnings, 78.7 per cent. Operating expenses included $288,547 paid in royalties and $208,348 for interest on the funded debt, the former absorbing 4.3 per cent. of gross earnings, and the latter 3.1 per cent.; a total for the two items of 7.4 per cent. It is evident, therefore, that the remaining items of operating expenses absorbed 71.3 per cent. of the gross earnings. The proportion of maintenance expenses to gross earnings is shown as follows: Gross earnings, $6,692,846; maintenance, $2,156,217; per cent. of maintenance to gross earnings, $32.2 per cent. This is a little higher than the average appropriation for maintenance by the Bell companies, which, according to President Fish, is about 30 per cent. of gross.

STREET RAILWAY GROSS EARNINGS.—The *Street Railway Journal* contains a summary of the gross earnings of 310 street railway companies of the United States for 1903, as shown by the figures in its annual valuable "Red Book" issued by the McGraw Publishing Company. The gross receipts of 42 companies having gross receipts of over $1,000,000 each amounted to $169,394,001, against $158,165,809 in 1902; 26 companies having gross receipts between $1,000,000 and $500,000 aggregated $18,019,575, against $16,279,419 in 1902; 100 companies with gross receipts between $500,000 and $100,000 totaled $22,875,139, against $19,638,636 in 1902; 91 companies with receipts between $100,000 and $50,000 amounted to $6,428,053, against $5,873,042 in 1902, and 51 companies with receipts between $50,000 and $25,000 aggregated $1,871,719, against $1,636,423 in 1902. The number of companies in the highest class, that is, those reporting receipts of over $1,000,000, has increased from 38 to 42, and all of these companies record an increase in gross receipts with one exception, where the decrease is due to local causes. The general average increase for 1903 over 1902 by the 310 companies compared is 8.5 per cent.

MEXICAN TROLLEY REPORT.—The report of the Mexico Electric Tramways, Ltd., for 1903 states that the result of the company's operations for the year, after charging interest on the debentures of the "Compania de Ferrocarriles del Distrito Federal de Mexico," and after payment of the 3½ per cent. guaranteed on the share capital of that company, shows a net profit of $135,785. The interest received on the debentures of the "Compania de Ferrocarriles del Distrito Federal de Mexico" and the dividend declared by the "Compania de Ferrocarriles del Distrito Federal de Mexico" on its share capital are then added, and after charging expenses and obligations, etc., a net balance is shown to the credit of profit and loss account of $77,725, which added to the balance brought forward gives the sum of $168,640. Out of this sum the usual dividend of 6 per cent. has been paid on the preference shares, amounting to $150,000, leaving a balance of $18,640 to be carried forward. The increase in the rates of exchange has resulted in a credit of $12,080, which has been placed to exchange suspense account.

INTERNATIONAL NICKEL.—Mr. Charles M. Schwab and his brother, Mr. Joseph H. Schwab, have sold their holdings in the International Nickel Company, according to information in Wall Street. The Schwab brothers were among the largest holders of the securities of the company, and were believed to be practically in control. It is understood that they sold their holdings to a syndicate and that their getting out of the company is only another proof of the desire of Mr. Schwab to reduce his outstanding interests in various concerns. The International Nickel Company was organized in 1902 with a capital stock of $12,000,000 preferred and $12,000,000 common stock. The funded debt of the company was $10,000,000. The company was a consolidation of a number of American and foreign nickel manufacturers, and it was claimed that it practically controlled the nickel output of the world. The president of the company is Ambrose Monell, formerly one of the right-hand men of Mr. Schwab in the Carnegie Steel Company.

DIVIDENDS.—The directors of the Massachusetts Electric Companies have declared the regular semi-annual dividend of 2 per cent. on the preferred stock. The Western Union executive committee has recommended the payment of the regular quarterly dividend of 1¼ per cent. A dividend of 1½ per cent. has been declared on Philadelphia

Union Traction stock, payable July 1. A dividend of $5 a share has been declared on West Philadelphia Passenger stock, payable July 1. A dividend of $4.75 has been declared on Philadelphia Union Passenger stock, payable July 1.

INCREASE OF STROMBERG-CARLSON CAPITAL.—The Stromberg-Carlson Telephone Manufacturing Company has decided to increase its capital stock from $4,500,000 to $6,000,000. It is stated that the Chicago factory will be closed and that all the manufacturing will be done at the company's factory in Rochester, N. Y. The common stock will be increased to 45,000 shares.

Commercial Intelligence.

THE WEEK IN TRADE.—The general situation is quiet and dull. The crop situation is still irregular, reports of improvement coming from some sections, while from others complaints are made. The volume of wholesale and retail business during May, *Bradstreet's* says, was disappointing, confirmation of this being found in decreases in bank clearings and in railroad earnings from a year ago, while failures were more numerous, though less costly than in recent months, but showing increases as compared with last year. There is, however, an underlying confidence in future trade, as is indicated by better inquiry for fall goods. Collections partake of trade irregularity, but are still fair. Among the industries iron and steel and bituminous coal are particularly depressed. Many furnaces are going out of blast, and curtailment continues. Finished products are generally quiet. Export business is expanding, the April shipments being double those of the same month last year. The lake tie-up is still unsettled. This affects shipments and general industry from Buffalo to Duluth. The market for copper was easy and ⅛c. lower at New York. Quotations are 12¾ @ 13c. for Lake, 12⅝ @ 12⅞c. for electrolytic, 12⅜ @ 12½c. for casting stock. The London copper market was lower. According to *Bradstreet's* statistics, there were 194 business failures during the week ending June 2d, as against 184 the previous week, and 157 the corresponding week last year.

ENGINE AND BOAT BUILDERS' ASSOCIATION.—The National Association of Engine and Boat Manufacturers has been formally organized this week in New York City. The membership roll was signed by forty-four of the leading manufacturers in these lines from all parts of the country. The charter of the association, under the laws of the State of New York, was received, and the constitution and by-laws were adopted. H. A. Lozier, of the Lozier Motor Company, presided, and E. W. Graef acted as secretary. It was decided to postpone the election of officers and an executive committee until the next meeting, which will be held at the Manhattan Hotel on June 27th. In the meantime Mr. Graef will communicate with the members and ask all who cannot attend to signify their choice for these offices. The objects of the association are in part as follows: To get special freight rates; to establish a bureau of information; to make special arrangements in regard to and to participate in the profits of shows, to protect its members against adverse legislation and questionable advertising schemes; to bring forward the new and improved methods in construction, and to take such action as will be in the interests of its members as regards alcohol as fuel. The membership of the association is as follows: The Lozier Motor Company, the Standard Machine Construction Company, the Bridgeport Motor Company, the Gas Engine and Power Company, the American Iron Works Company, the Buffalo Gas Machine Company, the Charles A. Strehlinger Company, the Toquet Motor Company, Panhard & Levassor, the Matthews Boat Company, the Isham Company, Fred Hock, the Delaware River Motor Company, Pilmer Brothers, the Standard Boat Company, the E. Gerry Emmons Corporation, Norwood Brothers & Co., the Eagle Bicycle Company, the Cushman Motor Company, the Wolverine Motor Works, Lacey Brothers, the Chase Pulley Company, A. Barrett's Sons, the Pearson Boat Construction Company, Termadt & Monahan, the Truscott Motor Company, the Pierce Engine Company, the White Craft and Power Company, Charles Durkee & Co., the Smalley Motor Company, the Miamus Motor Company, the Outing Boat Company, the Remy Electric Company, William Roche, the Stanford Motor Company, E. W. Graef, the Smith & Mabley Manufacturing Company, the Milton's Point Shipyards, T. S. & A. D. Negus, the Electric Launch Company, A. Paterson, the Motor Boat, Motoring and Boating, and the Automobile.

EQUIPMENT FOR BARBOUR FLAX MILLS.—The Barbour Flax Spinning Company, of Paterson, N. J., has awarded the important contract for the electrical equipment of its new shops to the Crocker-Wheeler Company. The equipment will comprise a 600-kw engine type, 110 r.p.m., 250 volts, direct-current generator, which will be direct connected to a 1,000-hp Corliss engine. There will be 25 standard motors, ranging in size from 5 hp to 25 hp each. Eighteen will have a capacity of 25 hp; two will be 15 hp; three will be 10 hp and two will be of 5 hp each—520 hp in all. The Crocker-Wheeler people have also secured the order for the switchboard.

MOTOR EQUIPMENT FOR LONG ISLAND MARBLE PLANT.—An extensive motor equipment has just been ordered for installation in the plant at Ravenswood, L. I., operated by the Traitel Marble Company. There will be 24 Crocker-Wheeler motors, practically all of which will be individual drive. The equipment will aggregate 275 hp in capacity. The motors will range from 2 hp to 35 hp. The machines will include standard, fully enclosed and semi-enclosed types. There will also be four grinders, built by the Bridgeport (Conn.) Safety Emery Wheel Company, Inc., which will be driven by Crocker-Wheeler motors.

EQUIPMENT FOR MEXICAN SUGAR PLANT.—The San Juan Sugar Corporation, of which Mr. E. V. Weems, of Winchester, W. Va., is president, will shortly let contracts through Mr. George T. Anderton, consulting engineer, 120 Liberty street, for a quantity of electric equipment to be used for lighting and largely operating a 1,000-ton sugar plant to be built on the Miller Plantation Company's property, State of Vera Cruz, Mexico. The contract for the boilers, 1,200 hp in four units, has already been awarded to the Sterling Co., 114 Liberty street, New York.

THREE THOUSAND HP NEW ZEALAND HYDRAULIC PLANT.—The Waipari Electric Power Company is to construct a plant on the Waipari River near Dunedin for generating current to operate the municipal electric traction system of that New Zealand city, whose lines are now worked from a steam plant. The initial capacity of the Waipari plant will be about 3,000 hp. The Pelton Water Wheel Company, 143 Liberty street, has been allotted the contract for the water wheels. The General Electric Company will build the generators.

EQUIPMENT FOR ABRAHAM & STRAUSS.—The contracts for the additional lighting equipment to be installed in the Abraham & Strauss store, Brooklyn, have just been awarded through Mr. C. O Mailloux, consulting engineer. There will be a 400-kw, 115-volt generator, which will be built by the General Electric Company and direct connected to a tandem non-condensing compound Corliss engine of 600 hp capacity. The engine contract went to the C. & G. Cooper Co., Havemeyer Building, New York City.

EQUIPMENT FOR NEW YORK BUTCHERS' DRESSED MEAT PLANT.—Contracts are about to be let for several motors, varying in capacity from 1 hp to 40 hp, wiring, coal handling machinery, etc., for installation in the New York Butchers' Dressed Meat Company's plant, New York City. The generators—two 400 kw and one 200 kw—will be built by the General Electric Company. The engines will be built by the Fitchburg (Mass.) Engine Company. Hogan & Slattery are letting the contracts.

MOTORS, ETC., FOR NEW GORHAM BUILDING.—It has been decided that the electric current to be used in the new Gorham Manufacturing Company Building, Thirty-sixth street and Sixth avenue, New York, will be taken from the Edison mains. About 200 hp of motors for ventilating apparatus will, however, be ordered very shortly through Mr. C. O. Mailloux, consulting engineer. There will be 2,400 16-cp incandescent lamps and a number of arcs used to light the premises.

TELPHERAGE FOR JAPAN.—The Imperial Government of Japan has just ordered from the United Telpherage Company, of 20 Broad Street, New York City, a second telpherage plant. The company some time ago installed one complete plant, and the Japanese were so well pleased with it that the second plant was ordered by cable. Shipment is to be made of complete plant in thirty days, which order the Telpherage Company with its increased facilities can promptly fill.

EQUIPMENT FOR PROCTOR & GAMBLE PLANTS.—A considerable quantity of electrical equipment is to be installed in the new soap making plant of Proctor & Gamble, at Kansas City. Robert W. Woodward, the mechanical superintendent of the company's chief plants at Cincinnati, Ohio, will let the contracts for the Kansas City equipment. The installation of further equipment in the Cincinnati works is also contemplated.

THE AMERICAN ELECTRIC TELEPHONE COMPANY of Chicago reports that its exchanges recently installed at Hot Springs, Ark., and Fort Worth, Tex., are operating very satisfactorily. Both exchanges are equipped with four party-line selective apparatus throughout. The adoption of the American Company's four-party selective system is held largely responsible for the immense success of the new company.

FANS FOR MONTEREY.—The Wesco Electrical Supply Co., of St. Louis, Mo., has secured a large contract for fans to be shipped to Monterey, Mexico.

General News.

THE TELEPHONE.

REDDING, CAL.—The Northern Trinity Telephone Company is to build a telephone line between Delta and Carrville, a distance of 25 miles. Mr. Carr is interested in the company.

EMMET, IDA.—The Rocky Mountain Bell Telephone Company plans the early construction of a line between this city and Roosevelt, in Thunder Mountain. The distance is 160 miles, and on account of the mountainous nature of the country the cost is estimated at about $100,000.

DECATUR, ILL.—The capital of the Macon County Telephone Company has been increased from $20,000 to $75,000.

GOLDEN, ILL.—The German Telephone Company has been incorporated with a capital stock of $5000. The directors are A. Baryell, D. G. Buss and others.

REDDICK, ILL.—The Reddick Mutual Telephone Company has been incorporated with a capital stock of $5000. The directors are James Reilly, I. G. McLane and others.

JOHNSTON CITY, ILL.—The Johnston City Telephone Company has been incorporated with a capital stock of $8000. The directors are C. E. McLintock, W. A. Roberts and others.

HARMONY, IND.—A new telephone exchange is being installed at this place, which will be connected with the Citizens' exchange of Brazil.

FLORA, IND.—The Flora & Bringhurst Co-operative Telephone Company has been incorporated with a capital stock of $13,000. The directors are W. F. Wagener, J. H. Coplin and others.

INDIANAPOLIS, IND.—The Stampers Creek & Orleans Telephone Company, of Orange County, has been incorporated with a capital stock of $200. The directors are B. F. Williams, H. McCoy and others.

INDIANAPOLIS, IND.—The New Telephone Company is preparing to extend its underground conduit system. When this work is completed a large area of the central portion of the city will be occupied by the conduits.

NEWCASTLE, IND.—Improvements calling for an expenditure of $25,000 are to be made by the two telephone companies here—the Central Union and the Independent. Several miles of new cable are to be put in and extensions of lines into the country in different directions are to be made. The extensive work marked out will require all summer to complete. Several of the toll lines are being doubled on account of heavy business.

INDIANAPOLIS, IND.—A peculiar telephone suit has been brought by Ashjian Brothers, a manufacturing firm of this city, against the Indianapolis Telephone company, to recover $5000 damages on account of the company having failed to place their name and number in the latest issue of its directory. Plaintiffs allege that the business of the firm has suffered great loss by the omission, and aside from the damages it is asked that the defendant company be required to issue a new directory.

ELWOOD, IND.—In an exciting race against time between the Central Union Telephone Company and the Delaware & Madison County Company, whereby the first in the field was likely to get the new suburban line from Elwood to Curtisville, the independent company won. The Delaware & Madison County Company had teams employed hauling poles all night and started three gangs of men to work erecting them at daybreak. All the farmers along the line and many of the Curtisville residents will be on the new system.

PORTLAND, IND.—The war between the city authorities and the Central Union Telephone Company has been waged for some time and the bitterness was increased by the city council passing a resolution ordering the arrest of any employe of the company found at work on the streets. The city authorities contend that the company has no franchise. The company disregarded the resolution and put its men to work and they were promptly arrested and charged with obstructing the streets. The city has brought quo warranto proceedings against the company to compel it to show by what right it seeks to plant poles in the streets. The company claims that a franchise was granted it in 1882, but has not produced the instrument.

EVANSVILLE, IND.—The telephone situation grows more interesting every day. The Home Telephone Company, recently organized, has applied to the Board of Public Works for a franchise and agrees to pay the city $4000 annually for 30 years and suggests allowing this money to remain in the hands of the telephone company at 3 per cent. interest, to be applied on the purchase price of the exchange by the city at any five-year period after the first ten years. Otherwise the city has the right to purchase the plant by paying one-half of the price stipulated in cash and the remainder in four annual installments. The company agrees to file a bond of $10,000 to have the plant completed and in operation within one year after granting of the franchise. The company also agrees not to assign to any company now in the field, or that shall be allowed to operate in the city, the franchise or contract granted to it by the city. The charges asked are as follows: Business telephones, $4; residence, $2; party line, $1. After 6000 subscribers are secured the company is given the right to increase the price 25 cents for each additional thousand. Immediately upon information that the Home Telephone Company had applied for a franchise the Citizens Telephone Company sent a communication to the council asking that it grant to the Home Telephone Company the franchise submitted by it, provided only that such conditions be imposed as will secure to the city the establishment of a system under that franchise within a reasonable time and the payment at once to the city of a sum sufficiently large to secure it from loss in case of any failure to establish such plant within such reasonable time. Also that conditions be imposed which will require and secure connection with independent long-distance telephones and that the maximum charges be no higher than those asked by the Citizens Company. The granting of a franchise upon such conditions will be sufficient to warrant the Citizens Company to withdraw its application for a franchise; for, if in good faith any other company offers better terms to the city, the Citizens Company does not care to intervene. The council has taken no action as yet upon the application of the Home Company or the withdrawal of the Citizens Company. The Home Company is composed of wealthy manufacturers, and it will not be surprising if this company does not yet build the new exchange in Evansville.

BONAPARTE, IA.—The Farmers' Connective Telephone Company has been incorporated with $10,000 capital stock.

SOUTH McALESTER, I. T.—Articles of incorporation have been issued to the Goodwater Telephone Company, of Goodwater, Okla. The capital stock of the company is $2000, and the incorporators are W. J. Whitemore, president; B. S. Harris, vice-president; W. H. McBrayer, secretary-treasurer.

CONCORDIA, KAN.—The Farmers' Central Telephone Company has been incorporated with a capital stock of $10,000.

HOME CITY, KAN.—The Home City Farmers' Mutual Telephone Company has been incorporated with a capital stock of $2100.

THIBODEAUX, LA.—The Cumberland Telegraph & Telephone Company is installing a new 400-line multiple board in its exchange here. It is also making other improvements to its system.

TRAVERSE, MINN.—The Farmers' Co-operative Telephone Company has been incorporated with a capital stock of $12,000.

WATERTOWN, MINN.—The Watertown Telephone Company has been incorporated with a capital stock of $25,000. F. A. Barth is president.

WINONA, MINN.—The Farmers' Co-operative Telephone Company has been incorporated with a capital stock of $12,000. The directors of the company are C. L. Nelson, F. E. Briggs and others.

HOPKINS, MISS.—The Rural Telephone Company, of Hopkins, has been chartered with $500 capital. W. N. Bailey and others are stockholders.

YAZOO CITY, MISS.—Both the Mutual and Cumberland telephone exchanges were destroyed by the recent fire at this place.

CLINTON, MO.—The Clinton Mutual Telephone Company has increased its capital stock from $20,000 to $50,000.

ST. LOUIS, MO.—The assessed valuation of the telegraph and telephone companies' properties in St. Louis County has been fixed by the County Court as follows: Bell Telephone Company, 110.33 miles of poles, $6619.80; 511.45 miles of wire, $5114.50, exclusive of incorporated towns, where it was valued at $60 a mile for poles and $10 a mile for wires. American Telegraph & Telephone Company, 42.65 miles of poles at $60 a mile; 314.74 miles of wire at $10 a mile, and 1029 feet of cable, $110. Kinloch Long-Distance Telephone Company, 15 miles of poles at $60 a mile, and 391 miles of wire at $15 per mile. Pacific Mutual Telephone Company 27.55 miles of poles at $60 a mile and 218 miles of wire at $10 per mile.

ODELL, NEB.—The Odell Independent Telephone Company has been incorporated with a capital stock of $10,000.

ARAPAHOE, NEB.—The Arapahoe Independent Telephone Company has been organized in this place by local capitalists. The company has an authorized capital stock of $20,000. The company has recently started business with 64 telephones connected.

NORTH WEARE, N. H.—The Weare Telephone Company has been organized. Frank Simmons and S. B. Herbert are among the directors.

BATAVIA, N. Y.—The village trustees have granted a perpetual franchise to the Bell Telephone Company for the operation of an exchange in this village. The company agrees in return to give the village $250 worth of service annually.

WALDO, OHIO.—The Waldo Bell Telephone Company has been incorporated with a capital stock of $5000. The directors of the company are J. D. Bower, W. F. Groll and others.

GREENVILLE, OHIO.—The Eldorado & West Manchester Telephone Company has been incorporated with a capital stock of $40,000. The directors of the company are W. D. Rush, R. S. Conkling and others.

OTTAWA, OHIO.—The Ottawa Mutual Telephone Company has been incorporated with a capital stock of $1000. The incorporators are C. O. Beardsley, J. H. Purnell, F. E. Smith, E. L. Tupper and George Fritz.

CINCINNATI, OHIO.—The Probate Court has decided that the Queen City Telephone Company is entitled to the use of the streets of Cincinnati for its wires, and prescribes the manner in which the franchise should be exercised. An appeal is to be taken.

BAKER CITY, ORE.—The Snake River Telephone & Telegraph Company will construct a telephone line down the Snake River to the Iron Duke mine and connect with other mining and agricultural systems in that region.

UNIONTOWN, PA.—The telephone line to connect Uniontown with Pittsburg over the lines of the Tri-State and Pittsburg & Allegheny Telephone Companies has been completed. The Tri-State Company has 2000 subscribers in Lafayette County and covers practically the entire county.

SCHULENBERG, TEX.—The Schulenberg Telephone Company has been incorporated with a capital stock of $5000. The directors are W. E. Perlitz, John Schumacher and others.

SEATTLE, WASH.—An organization of all the independent telephone companies in Washington is being proposed by the Independent Telephone Company of this city. This would give them a long distance service and enable them to compete effectively with the Rocky Mountain Bell system.

PRAIRIE DU CHIEN, WIS.—The Star Telephone Company has been incorporated with a capital stock of $14,000. The directors are M. Menges, J. A. Haggerty and others.

ELECTRIC LIGHT AND POWER.

SEWARD, ALASKA.—Albert Higginson, George Bohus, Harry Kennedy and W. E. Catzdanner have secured a franchise for an electric light plant in this place. They will soon start work on a plant of 1700 lights capacity.

CAMDEN, ARK.—The Fensenthal Land & Townsite Company, Camden, proposes constructing water works, an electric light plant and telephone system, but no definite plans have yet been made.

OCEANSIDE, CAL.—Bids are wanted July 5 for a gas and electric light franchise. H. D. Brodie is City Clerk.

EUREKA, CAL.—John M. Vance, president of the Humboldt County Bank, is reported interested in the construction of a power plant and the transmitting of power to this city.

SAN FRANCISCO, CAL.—The Merced Falls Power Company, controlled by the Crocker Estate, has ordered through the Wagner-Bullock Electric Company, a 225-kw polyphase Bullock generator.

IMPERIAL, CAL.—The Holton Power Company, of Imperial, has closed a contract with the Wagner-Bullock Electric Company for an 800-hp Bullock railway generator to operate an electric road.

RIVERSIDE, CAL.—W. D. Woolwine, of Los Angeles, has been appointed receiver for the Riverside Power Company. This action grows out of the foreclosure suit of the Mercantile Trust Company of San Francisco.

ALAMEDA, CAL.—The monthly report of the Municipal Electric Light Department shows expenses for April to have been $22,006 and the earnings $1223. These earnings, it is said, are almost $300 in excess of those of the corresponding period last year.

SAN FRANCISCO, CAL.—The new board of directors of the California Gas & Electric Corporation, organized by re-electing the following officers: E. J. de Sabla, Jr., president; John Martin, first vice-president; F. G. Drum, second vice-president; R. M. Hotaling, treasurer, and C. W. Conlisk, secretary. John A. Britton is manager and G. Baum remains superintendent.

ETNA, CAL.—The Siskiyou Electric Power Company on June 1 took over the electric plant of the Etna Development Company. The Siskiyou Company, which has a capacity of 3500-hp at its plants, located at Fall Creek, and elsewhere, lights Ashland, Ore., Fort Jones and other California towns. A line will be constructed to Salmon River to furnish power for the quartz mills.

SANTA MARIA, CAL.—The Santa Maria Power & Lighting Company has filed articles of incorporation to furnish electric light and power in this city. The capital stock is $50,000, nearly all of which is held by Los Angeles and Pasadena men. The first board of directors is composed of H. T. Duff, W. F. Gibbs, R. H. Pallard and F. C. Armstrong, of Los Angeles, and B. E. Page, of Pasadena.

SAN FRANCISCO, CAL.—The Mt. Lassen Water Power Company, which has been incorporated by Archibald Barnard, L. M. Robbins, A. G. Sheath, M. A. Kenney and A. E. Bennett, has a capital stock of $500,000. The principal place of business is San Francisco. Harry L. Shannon has secured the necessary money to purchase machinery for the water power electric plant, which this company was organized to construct in Shasta County, Cal. It will be in a position to compete with the Northern California Power Company, which transmits to Redding and many other points. The initial installation will include a 1500-hp direct connected 3-phase generator, the water wheel operating under a head of 1500 feet. Water will be taken from Flat Creek, just below Mt. Lassen, and carried six miles to Bear Creek by ditch and flume. Thence a pipe line will supply water to the power house near Bear Creek Falls. The plant is to be in operation Jan. 1, 1905. A second unit will be installed later.

SAN FRANCISCO, CAL.—The North Mountain Power Company has closed contracts through the Wagner-Bullock Electric Company of San Francisco for two 75-kw, 3-phase Bullock generators, arranged for direct connection to Stilwell-Bierce water wheels. A third unit will soon be ordered. The 25-cycle machines will generate 2200-volt current at 500 r.p.m. Transformers for the generating capacity have been ordered in 300-kw units, with one spare bank. There will be several sub-stations. The power station will be built at a point 40 miles west of Redding in Humboldt County, and energy will be transmitted 75 miles to Eureka at 33,000 volts. Current for lights, power and electric railways will be supplied. This plant will be only a beginning and the system will be developed until 25,000-hp or more will be available for transmission to all of the important towns, mines and manufactories of Northwestern California. Early deliveries of machinery will be made and the initial plant installed in time to open for business before Jan. 1, 1905. An available head of 600 feet of water will be utilized. The North Mountain Power Company has a capitalization of $500,000. John M. Vance and Wm. Carson, of Eureka; John L. Koster, F. J. Koster, D. G. Schofield and R. J. Tyson, of San Francisco, are stockholders. J. C. Ralston, chief engineer, has commenced work at both ends of the proposed transmission line. For several years the company has been examining the mountain streams of Humboldt, Mendocino, Trinity, Del Norte and Siskiyou counties. The water rights and ditches of the Compagnie Francaise, doing business in Trinity County, have been purchased and an electric power plant will be installed in that mining district.

CHESHIRE, CONN.—The large transforming station of the Connecticut Railway & Lighting Company in this place is now completed. The main station is at Bull's Bridge, near New Milford, where there is a hydraulic plant. Electrical energy is transmitted to Cheshire at a pressure of 30,000 volts.

SEYMOUR, CONN.—W. H. H. Wooster and George E. Matthies, who control the Seymour Mfg. Company, Seymour, Conn., have bought the property of the Seymour Electric Light Company. Both industries depend upon water privileges one above the other on the Naugatuck River, and the best economy and results can only be obtained by working the plants in harmony.

KEY WEST, FLA.—The Key West Electric Light Company has absorbed the Electric Light & Power Company of this city. For the present both the plants will be operated. New machinery has been ordered and as soon as it is installed the power will be furnished from the Key West Electric Company's plant. The Electric Light & Power Company will continue the manufacture of ice.

MILLEDGEVILLE, GA.—Chas. F. Howe, manager of the Oconee Electric Light & Power Company, states that it is proposed to expend from $500,000 to $750,000 in improvements. The company will do the work itself.

MACON, GA.—An application for a charter for the Piedmont Power Company has been filed. The company proposes to generate power from the water streams of the State; also utilize the Oconee and the Ocmulgee for the generation of electricity for power, lighting and heating plants and for the operation of street cars. The capital is $2,000,000. Robt. L. Park, F. M. Marriot and Wm. A. Carlisle are the incorporators.

QUINCY, ILL.—The Quincy Gas & Electric Company has perfected plans which will require an expenditure of $50,000 for improvements during the coming summer.

MT. VERNON, IND.—The Mt. Vernon Electric Light & Power Company has been incorporated; capital, $5000. Directors: Jesse H. Purdy, Geo. E. Hoffmaister, Harry B. Rhine and others.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company will improve and enlarge its plant at New Jersey and Pearl Streets this summer. James B. Nelson is general manager.

FORT WAYNE, IND.—It is stated that the Fort Wayne Electric Light & Power Company has been sold to Eastern capitalists at a price a trifle over $500,000. It is further stated that the new owners will consolidate the company with the traction interests of the Fort Wayne & Wabash Valley lines. Mr. Randall Morgan, of Philadelphia, is interested in the deal.

WEST POINT, IA.—The council is securing estimates of cost for an electric light plant.

WILTON JUNCTION, IA.—The proposition to issue $5000 electric light improvement bonds was carried at a recent election.

FT. MADISON, IA.—Samuel Atlee is reported to have purchased the franchises recently granted F. C. Wood for an electric light plant and interurban railway system and for a gas plant.

WICKLIFFE, KY.—R. E. Gannon, of Cairo, has secured the contract for an electric light plant for Wickliffe, at $6042.

HOPKINSVILLE, KY.—The electric light plant owned by the Hopkinsville Gas & Lighting Company was destroyed by fire May 22, entailing a loss of $30,000.

INDIAN ORCHARD, MASS.—An electric light and power plant will be installed in the works of the Massachusetts Fiberloid Company of this place. The plant will have a capacity of 1000-hp, and 1000 incandescent lights will be installed.

MANTON, MICH.—The citizens have voted to issue $8000 electric light and water bonds.

SCHOOLCRAFT, MICH.—The electric light plant at this place was destroyed by fire on May 15.

SAULT STE. MARIE, MICH.—The Sault Edison Company is preparing to construct an electric light plant.

JANESVILLE, MINN.—It was voted May 16 to issue $25,000 bonds for the construction of water works and an electric light plant.

OXFORD, MISS.—The citizens voted May 20 to make improvements to the electric light plant.

HATTIESBURG, MISS.—The City Clerk writes that the matter of constructing an electric light plant, for which $60,000 bonds were to have been issued, has been postponed indefinitely.

LOUISIANA, MO.—The Louisiana Gas & Electric Light Company is contemplating improvements in its plant.

SEDALIA, MO.—A charter has been granted the United Water, Gas & Electric Company, of Sedalia, with a capital of $1,000,000. This concern is a consolidation of the companies formerly doing business in this place.

TEKAMAH, NEB.—The electric light plant at this place was damaged by a tornado on June 2, and the town is in total darkness.

CAMBRIDGE, NEB.—The Cambridge electric light plant, which has been operated under the management of P. B. Cole, has been organized as the Cambridge Electric Light Company with a capital of $10,000. Directors: W. H. Faling, J. H. Rosenfelt, E. C. Rodwell and others.

VIRGINIA CITY, NEV.—The Truckee River General Electric Company will install an addition to its present plant of between 2000 and 3000-hp, and will build a new 35-mile line and a sub-station during the present summer. Surveys are now under way, the plant to be driven by water power.

TRENTON, N. J.—Richard Stockton, of this city, has been named as receiver for the Freehold Electric Light, Heat & Power Company on the complaint of Mr. Charles P. Fitch, of Beverly.

JERSEY CITY, N. J.—The Commonwealth Electric Company has been incorporated with a capital of $100,000, to furnish light, heat and power. Registered office, 15 Exchange Place, Jersey City.

CAMDEN, N. J.—The Lighting Committee has awarded a 5-year contract to the Public Service Corporation Company to furnish arc lights at $109 per year per lamp. There are 524 lamps. The total cost per year will be $57,378.

ROSWELL, N. M.—The Roswell Electric Light & Power Company is extending its system, for which work material has already been ordered.

ADDISON, N. Y.—It is proposed to rebuild the electric light plant recently burned. Address F. W. Wheaton.

GOWANDA, N. Y.—It is said to be the intention of the Gowanda Electric Light Company to rebuild the dam across Cattaraugus Creek and operate its dynamos with water power.

LOCKPORT, N. Y.—It is stated that the Niagara, Lockport & Ontario Power Company will build the canal under the present charter and seek an amendment next year, which will authorize it to sell power to all counties of the State instead of only Erie, Niagara and Orleans.

BUFFALO, N. Y.—The Le Roy Hydraulic Electric Company, the Le Roy Gas & Electric Company and the Le Roy Power Milling Company have been consolidated, the new capital being fixed at $100,000. A number of improvements in the plant are to be made and the business considerably extended.

ALBION, N. Y.—The Albion Electric Light, Power & Gas Company, of Albion, which is also owner of the electrical plants at Waterport, Brockport and Middleport, is reported interested in a deal to develop a large water power at the latter village, approximating in the neighborhood of 25,000 horse-power.

ROCHESTER, N. Y.—The merger certificate of the Rochester Gas & Electric Company and the Municipal Gas & Electric Company has been filed with the Secretary of State. The filing of the papers was made necessary at this time on account of the proposed merging of the Rochester Railway and the gas and electric companies into the new Rochester Railway & Light Company.

ALBANY, N. Y.—The Kings County Lighting Company has been incorporated with a capital stock of $2,000,000 to manufacture and supply gas and electricity in Brooklyn and Queens Boroughs, New York City. The directors are Ashley T. Cole, Charles T. Lark, New York City; William J. Bagnall, Bayonne, N. J.; Alex. Keogh, New Rochelle, and W. R. Fuller, Brooklyn.

LAWNDALE, N. C.—The Lily Mill & Power Company, of Lawndale, is authorized to increase its capital stock from $50,000 to $100,000.

GREENVILLE, N. C.—Bids will be received on June 22 by the Board of Internal Improvements (L. J. Hooten, chairman) for the construction of an electric light plant.

LIDGERWOOD, N. D.—The council is considering the construction of an electric light plant.

WIMBLETON, N. D.—Fred Zollner, of Courtenay, N. D., has purchased the electric light plant here, and will install new machinery.

WEST MILTON, OHIO.—The matter of establishing an electric light plant is under consideration.

DOYLESTOWN, OHIO.—The proposition to issue $10,000 municipal lighting bonds will shortly be submitted to a vote of the people.

FREMONT, OHIO.—It is stated that the Fremont Light & Power Company is to utilize the water in Sandusky River here and erect a large power plant.

SUMPTER, ORE.—The Sanger Gold Mines Company proposes to construct a power plant at the mines, to cost about $100,000. J. K. Ronig, Baker City, is superintendent.

CLEVELAND, OHIO.—Bids will be received July 12 by H. H. Bohning, village clerk, of Newburgh Heights, for furnishing material and lighting the streets in that village.

NEWTON FALLS, OHIO.—The Village Council has awarded a 10-year contract for lighting the village with electricity to E. E. Mandeville, of Philadelphia, Pa. He is to build and equip the plant, and furnish 16 arc lights at $70 per lamp. A twenty-year franchise for commercial lighting and furnishing power also went with the contract.

MECHANICSBURG, PA.—Bids are wanted July 1 for electric lighting the city. Murray H. Spahr is chairman of the Light Committee.

BLOOMSBURG, PA.—The newly incorporated Irondale Electric Light, Heat & Power Company, of Bloomsburg, proposes to supply Bloomsburg, Catawissa, Rupert and Danville with electricity.

PHILADELPHIA, PA.—The Philadelphia Electric Company is said to be about to award contract for two more 7000-hp generator units for the Gray's Ferry plant similar to the General Electric unit now installed.

HANOVER, PA.—A charter has been granted to the Hanover Electric Power & Heating Company of Hanover, with a capital of $50,000, represented by Geo. Gitt, Chas. Delone, Thos. O'Neil and others, to construct a heating system.

MT. PLEASANT, PA.—The Hartigan Electric Light, Heat & Power Company, with John F. Hartigan, J. L. Kalp and others, of Mt. Pleasant, as directors, are about to apply for a charter to supply light, heat and power by electricity in Mt. Pleasant.

PITTSBURG, PA.—The United Electric Company of Wilmerding, which was formed recently, has placed an order with the Westinghouse Machine Company for two 200-hp engines and has contracted with the Westinghouse Electric & Mfg. Company for two 150-kw generators. This equipment is to be installed in its new plant, work upon which is now going forward.

PITTSBURG, PA.—An application has been made for a charter for the Great Tunnel Company, the object of which is to construct tunnels under the cities of Pittsburg and Allegheny for the transportation of freight. The motive power is to be electricity and the system is to be modeled after the one now in use in Chicago. Among those interested in the enterprise are Ralph E. Flinn and J. S. Weller.

YORK, PA.—The York Haven Water & Power Company has filed a mortgage for $1,000,000 in favor of the Land Title & Trust Company of Philadelphia to secure a second mortgage bond issued for that amount. The proceeds will be used for equipment, extensions, etc., as the business of the company demands. The rebuilding of that portion of the plant of the York Haven Power Company which was destroyed by the high water and ice several months ago is nearly completed. The plant will hereafter be better protected from like damage.

BATESBURG, S. C.—It was voted May 24 to issue $20,000 bonds for constructing water works and an electric light plant. J. C. Glover is City Clerk.

BATESBURG, S. C.—The town of Batesburg has voted a sum not to exceed $20,000 for water and light plants and other public improvements. W. H. Timmerman is on the committee having in hand the issuing of the new bonds.

BROWNSVILLE, TEX.—The City Council has granted Judge Jas. B. Wells, of Brownsville, a franchise for water works and an electric light plant. He will also establish an electric light plant at Matamoras, Mex.

SALT LAKE CITY, UTAH.—An expert appointed by the city council to investigate the alleged poor and irregular light service of the Utah Light & Railway Company has submitted a report, stating that the city is receiving all the electrical energy called for in the contract. There has been much criticism of the company's service, and the establishment of a rival power plant is being seriously considered.

BURLINGTON, VT.—It is proposed to construct an electric light plant here to cost $59,000.

WEST POINT, VA.—Bids will be received by the Town Council on June 10 for sale of a franchise to light the town by electricity.

PETERSBURG, VA.—The Finance Committee of the Council is considering the construction of an electric light plant.

HARRISONBURG, VA.—The Council is stated to have decided to install a municipal electric light plant costing about $70,000. The power will be secured from the Shenandoah River.

MOUNDSVILLE, W. VA.—The council has granted a franchise to the Moundsville Electric Company. A 50-year extension was granted, and the company now has the plans for a $25,000 plant ready.

CHARLESTOWN, W. VA.—The authorities of Charlestown have taken steps to annul the franchise of the Kanawha Water & Light Company, on the alleged ground that the company has failed to comply with the terms of its franchise.

WITTENBURG, WIS.—The Central Construction Company, of Oshkosh, Wis., has secured the contract for an electric light plant. The probable cost is $10,000.

BERLIN, WIS.—Bids are wanted July 1 for furnishing and providing, on moonlight schedule, 46 electric arc street lamps for the terms of 5 and 10 years from June 1, 1905, and such additional lamps as the city may require from time to time. Henry Morman is City Clerk.

MILWAUKEE, WIS.—The finance committee of the common council here has voted unanimously to recommend a bond issue of $150,000 for the purpose of establishing a municipal electric lighting plant. This matter has been agitated in Milwaukee for a long time and has been endorsed by all the political parties. Plans and estimates have been made by the city engineer and Jones Island is favorably considered for the location of the plant.

LARAMIE, WYO.—David McCullagh, City Clerk, writes that the city would like to correspond in regard to the construction of an electric light plant. The council is talking of installing a municipal plant.

RAT PORTAGE, ONT.—The town of Rat Portage contemplates building a new power station.

BRANDON, MAN.—A charter has been granted to the Western Light & Power Company, of Brandon, with a capital of $300,000, to install an electric plant on Assiniboine River. J. M. Robinson and John Russell, of Brandon, are among the incorporators.

THE ELECTRIC RAILWAY.

BESSEMER, ALA.—Estimates of the engineers place the cost of constructing the 16 miles of line between Bessemer and Brookwood at $200,000. S. E. Jones, of this place, is interested.

OPELIKA, ALA.—The Opelika Railway, Light & Power Company has been incorporated and will build an electric road from Opelika to Auburn, a distance of ten miles. J. B. Greene, E. L. Andrews and others are the incorporators.

SAN JOSE, CAL.—The directors of the San Jose, Los Gatos & Interurban Railway Company have under consideration the proposal to establish and install a power plant in the vicinity of the present car houses. The plant will cost between $75,000 and $100,000.

VALLEJO, CAL.—The Vallejo, Benicia & Napa Valley Railroad Company has secured all the rights of way for its line from Napa to Vallejo, a distance of 16 miles. The rails have been purchased, as have also the electrical equipment, trolley poles and ties. The road is expected to be in operation about Aug. 1. The officers of the company are John Cross, president; J. W. Hartzell, second vice-president; J. E. Loomis, secretary. The main office of the company is in Los Angeles.

GREENWICH, CONN.—President Charles Singer, of the New York and Stamford Railway has inaugurated a parlor trolley service, charging double fare for seats in the parlor car and running it between Port Chester and Rye Beach.

GAINESVILLE, GA.—The Gainesville & Dahlonega Electric Railway Company, which has under way the preliminaries for the construction of an electric railway between Gainesville and Dahlonega, has organized as follows: A. J. Warner, president; W. A. Charters, vice-president; W. A. Carlisle, secretary, and J. F. Moore, of Dahlonega, treasurer.

CHICAGO, ILL.—Attorney Charles Aldrich has filed application at Washington for a writ of certoriari from the United States Supreme Court in the case attacking the validity of the Union Traction leases.

ALTON, ILL.—Representatives of J. G. White & Co., of New York, have arrived in Alton to begin preliminary work on the new interurban electric railway between Alton and St. Louis. W. T. Davis will be the superintendent of construction. Work will be commenced at once. The line will connect the Alton system with the extension of the Granite City line, which has been completed as far as Nameoki.

BELLEVILLE, ILL.—It is said that the Southern Illinois Electric Railway Company has abandoned its project for building an electric railway from Okawville through Venedy, New Memphis and Mascoutah, and thence to Belleville to connect with the East St. Louis & Suburban Railway. Donahue Brothers, of St. Louis, who had the contract for grading the line, have pulled stakes and deserted the field.

KANKAKEE, ILL.—The Kankakee Interurban Riverview Railway Company will begin within thirty days the construction of its proposed line from Kankakee to Waldron and Momence, Ill., and thence from Waldron to St. Anne. There will be 30 miles of road in all. The officers of the company are H. T. Bonfield, president and purchasing agent; J. D. Dixon, treasurer; E. W. Bonfield, secretary. The main office of the company is at Kankakee.

MARION, IND.—The Indiana Union Traction Company has acquired the Kokomo, Marion & Western Traction Company and will push the completion of the line into Marion.

CRAWFORDSVILLE, IND.—The Northwestern Traction Company is constructing a modern telephone system between this city and Lebanon, and will soon be ready for the transmission of messages by the conductors regarding the movement of trains and the other business of the company.

EVANSVILLE, IND.—The County Commissioners have granted a franchise to the Evansville & Eastern Electric Railway Company for the right of way through Knight Township. This is the proposed new line between Evansville and Rockport. The company is given the right to furnish light, heat and power in Vanderburg County.

LOUISVILLE, IND.—The Louisville & Southern Indiana Traction Company has secured possession of the Highland Electric Railway Company. The Highland Company has not been in operation for several months. It was built about fourteen years ago, and at first was a paying investment, but of late years the company lost money, and last fall the company stopped operating its cars. The purchaser will rebuild the line and make it part of its system.

EVANSVILLE, IND.—The three electric traction projects planned to run from Evansville to Rockport are pushing their respective arrangements. The survey of the Evansville & Eastern has been completed and the right of way nearly all secured. The Evansville, Booneville & Rockport has obtained a right of way and reports that the road is financed. The Evansville, Newburg & Rockport, a steam line, is to be converted into an electric road at once.

GOSHEN, IND.—Promoters of the Kalamazoo & Lake Shore Traction Company have commenced work on the line that is to connect Benton Harbor, Niles and Kalamazoo. A mortgage for $600,000 has been filed in the register of deeds office in St. Joseph by the company. The American Trust & Savings Company holds the paper and is therefore to provide the money for the construction of the road to Kalamazoo along the lake shore. Work is in progress on the line between Benton Harbor and Paw Paw Lake.

CLINTON, IA.—The Iowa & Illinois Interurban Railway Company's shops, car houses, power houses and office building will be located in this city. The company is building an interurban road between Clinton and Davenport, a distance of 42 miles. About half the grading has been completed and several miles of track have been laid.

ARKANSAS CITY, KAN.—The Kansas-Oklahoma Interurban Railway Company, which was chartered May 10, with general offices at Arkansas City, Kan., organized on May 21 as follows: W. C. Robinson, of Winfield, Kan., president; S. H. P. Northrup, of Arkansas City, Kan., vice-president and general manager; W. D. Sanders, of Arkansas City, Kan., secretary and treasurer; C. L. Brown, of Arkansas City, Kan., general attorney; T. V. Holl, of South McAlester, I. T., chief engineer.

NEW ORLEANS, LA.—A large contract has been closed by Knox, George & Co. It comprises the construction of an interurban railway line at Birmingham which will cost, when completed, about $800,000. The new road, which will be known as the Birmingham & Steel Cities Railway & Power Company, will construct 40 miles of road, which, while operated in the same general district as that covered by the older company, will open up entirely new territory. The line will run from Birmingham to such outlying cities as Ensley, Pratt City, Bessemer and surrounding towns and factory districts.

PRINCESS ANNE, MD.—The Somerset & Wicomico Power, Light & Railway Company has organized as follows: Fillmore Lankford, of Princess Anne, president; Lloyd Riggin, of Crisfield, secretary, and S. Frank Dashiell, of Dames Quarter, treasurer. A committee has been appointed to select a route between Salisbury and Crisfield.

GRAND RAPIDS, MICH.—The contract for building the Grand Rapids & Ionia Electric Railway has been let to the Farnham Construction Company, of Chicago, work to commence before July 1 and to be completed not later than March 1, 1905. The power house will be located at Saranac, from which place construction will be pushed in both directions.

MINNEAPOLIS, MINN.—The Pioneer Electric Railway Company, of Minneapolis, has been incorporated with a capital stock of $100,000, to construct an electric railway from White Rock to Minneapolis and St. Paul. The incorporators are P. W. McAllester, Herman F. Johnson, Fremont D. Woodbury and B. F. Cooper, of Minneapolis, and Anton W. Holmes, of St. Paul.

KANSAS CITY, MO.—A sub-station is being built by the Metropolitan Street Railway Company at Twelfth Street and Cleveland Avenue. It will supply several of the East Side car lines with power. When this work is completed the Blue River power plant will be overhauled and improved.

ST. LOUIS, MO.—The United States Railways Company's electric rolling stock in St. Louis County has been assessed at $40,000; 2.43 miles of double track on public highways at $12,000 a mile; 6.54 miles of single track on public streets at $6000 a mile; 14.33 miles of double and 3.88 miles of single track private right of way at $12,000 and $6000 a mile, respectively. St. Louis and Suburban, 11.766 miles of single track at $6000 a mile, and improvements, $58,000. St. Louis and Kirkwood, 12.477 miles at $8000 a mile, and improvements, $37,150. St. Louis and Meramec River Railway Company 13.422 miles at $12,000 a mile, and improvements, $33,000. Brentwood, Clayton and St. Louis, 12.489 miles at $10,000 a mile, rolling stock, $12,000. St. Louis, St. Charles and Western, 15.567 miles of single track at $6000 a mile.

OMAHA, NEB.—The Omaha, Lincoln & Beatrice Railway, which plans to build an electric railway to connect Omaha, Lincoln and Beatrice, has filed with the Secretary of State articles increasing its capital stock from $200,000 to $2,250,000. Henry Robinson, of Akron, Ohio, is president. Contracts for equipment, it is stated, have been closed.

NEW YORK, N. Y.—The board of estimate and apportionment has voted unanimously in favor of accepting the report made by Comptroller Grout giving the New York, Westchester & Boston Railway Company the right of an entrance over the streets of the city, and compensation to be paid for the same.

NIAGARA FALLS, N. Y.—The Thorold & Lake Erie Railway Company has a bill before the Canadian Parliament to permit it to construct an electric railway from Thorold to Welland and thence to Port Colborne and Buffalo; also a line to Brantford. The idea is to operate the electric railway so that passengers passing through the Welland Canal on any of the Wolvin Company's boats, may make a side trip to the falls by electric railway and meet the boat farther down the canal. The bill is meeting with a great deal of encouragement.

CLEVELAND, OHIO.—A franchise has been granted by the City Council to a proposed street railway company, which is to charge a 3-cent fare. It is the first franchise of its kind in the city. Mayor Johnson is said to be interested in the new line, which, according to the conditions of grant, must be in operation by April 1, 1905.

BAKER CITY, ORE.—Of the proposed issue of $5,000,000 bonds of the Baker City & Oregon Wonder Electric Railway and Improvement Company, $500,000 was recently negotiated by Major Bonta, the promoter, the bonds having been taken by the North American Trust Company of New York. The railway company plans the construction of a system which will extend from this city throughout the southern portion of the state and finally connect with a transcontinental system in Nevada or California. The first line to be built will be to Prairie City, a distance of eight miles, and it is estimated that in this undertaking $750,000 will be expended on construction work and equipment. This does not include the power plants which are planned by the company, although not for the immediate future. Branch lines will be run from the main line to numerous small towns in Southern Oregon.

GREENVILLE, PA.—The Greenville Street Railway Company has been incorporated. William C. Wibert and Samuel G. Bailey, of Pittsburg, are interested.

CONNELLSVILLE, PA.—It is reported that the Pittsburg, McKeesport & Connellsville Street Railway has decided to build a line from Leckrone to Masontown.

JOHNSTOWN, PA.—A charter has been issued at Harrisburg for the Pennsylvania Street Railway Company to build an electric railway from Spangler to Moss Creek, a distance of three miles. The company has a capital of $18,000. F. Marstaller is president. The Pennsylvania Coal Company is understood to be interested in the project.

LANCASTER, PA.—The stockholders of the Lancaster & Mount Joy and Lancaster & Rohrerstown electric railways have decided to merge the two companies into one under the name of the Lancaster, Rohrerstown & Mount Joy Railway Company. The officers elected are Charles B. Keller, president; John S. Graybill, Jr., secretary and treasurer.

DANVILLE, PA.—The Danville & Bloomsburg Electric Railway Company has commenced the construction of its proposed road to extend from Danville to Bloomsburg, a distance of 10 miles. As soon as the bridge over the Susquehanna River is rebuilt the line will extend to South Danville and thence to Snydertown, where it will connect with the proposed Shamokin & Sunbury line.

CLEARFIELD, PA.—An ordinance has been introduced in the Town Councils of Clearfield and Curwensville, granting a franchise to the new Clearfield & Curwensville Street Railway Company. The proposed line will be 12 miles in length. The officers are E. A. Irvin, of Curwensville, president; W. H. Denlinger, R. D. Swope, C. E. Patton, A. W. Lee, F. G. Harris, W. I. Betts, E. W. Hess, F. G. Betts and T. L. Snyder, directors.

CHAMBERSBURG, PA.—The engineering corps of the proposed Catoctin & Myersville Electric Railroad has completed the survey to Pen Mar, where connection is made with the Chambersburg, Gettysburg & Waynesboro Electric Railway. The line as surveyed for the Catoctin & Myersville road runs from the Frederick-Middletown line at Myersville to Pen Mar station, on the Western Maryland Railroad, a distance of 22 miles. The corporation of the new road has elected the following officers: J. H. Maugans, president; A. L. Hauver, vice-president; H. H. Warrenfeltz, secretary; Charles U. Grossnickle, treasurer.

NASHVILLE, TENN.—A meeting of the promoters of the Nashville & Columbia and the Nashville & Gallatin interurban lines was held a few days ago, at which officers and directors were selected. The capital stock of the former road was increased from $50,000 to $2,000,000, and of the latter from $50,000 to $2,000,000. The following officers were elected; Nashville & Columbia, H. M. Gross, of Pittsburg, president; Thos. E. Perry, Jr., of Pittsburg, vice-president Nashville & Gallatin, H. M. Gross, of Pittsburg, president; Thos. E. Perry, Jr., of Pittsburg, vice-president; J. H. Connor, general manager. John H. Connor has accepted the contract for building the road from Nashville to Franklin, and the building of the power house at this point and two substations along the way.

DALLAS, TEX.—A movement is on foot to build an interurban electric railway from this city to Grand Saline, Tex., a distance of about 65 miles. A number of Dallas capitalists are interested in the project.

HOUSTON, TEX.—The charter of the Houston-Galveston Interurban Railway Company has been filed. The company is formed for the purpose of building an electric railway between Houston and Galveston, a distance of 51 miles. It has a capital stock of $250,000. The directors are James R. Patton, of Kansas City; Charles D. Graham, of Fairview, Kan.; T. W. Allen, of Greenup, Ill.; Walter Gresham, of Galveston; O. M. Whitcomb, of Webster, Tex.; W. E. Scott, W. B. Slosson, N. C. Abbott and J. Edgar Lafferty, all of Houston. The principal office is in Houston.

NORFOLK, VA.—Stockholders of the Chesapeake Transit Company have authorized an increase of capital stock from $1,000,000 to $1,500,000. This money will be used in carrying out improvements.

RICHMOND, VA.—The Citizens Rapid Transit Company has completed all details for building a new trolley line in Richmond from Brook Avenue to Fulton and the contracts have been let for the material and work. The new road complete will represent an outlay, it is said, of over $500,000. The new company has been quietly organized by Richmond and Northern capitalists, and is most substantially backed.

ST. ALBANS, VT.—At the annual meeting of the stockholders of the Mount Mansfield Electric Railway Company, the following officers were elected: A. H. Soden, president; C. D. Pike, vice-president; L. C. Moody, of Waterbury, secretary; W. B. McCutcheon, treasurer; F. L. Shepard, general manager.

PARKERSBURG, W. VA.—The Parkersburg, Marietta & Interurban Railway Company is extending its present power station at Parkersburg, W. Va., and installing Westinghouse-Parsons steam turbines. A 400-kw unit will be installed for the present which will operate on 150 lbs. steam and 28 inch vacuum. Steam will be furnished by water tube boilers without superheater. The generator will furnish 2-phase, 60-cycle current at 2200 volts to a single-phase distribution system supplying current for local lighting. The turbine unit will operate in parallel with the present equipment of the plant, which consists of Westinghouse compound engine generating outfits of the belted type.

NEW INDUSTRIAL COMPANIES.

THE GEMMILL TELEPHONE COMPANY has been formed at Barberton, Ohio, and will commence the erection of a factory building to manufacture telephones.

THE CENTRAL CALIFORNIA ELECTRIC COMPANY has been incorporated at Tuolumne with a capital stock of $500,000, and the incorporators are J. L. Gibbs, G. G. Grant and J. E. Conde.

THE TRITT ELECTRICAL MANUFACTURING COMPANY, of South Bend, Ind., has filed articles of incorporation with the Secretary of State. The capital stock is $15,000. The directors are B. S. Tritt, A. H. Calvert and C. H. Kreighbaum.

THE ELECTRICAL & CHEMICAL GAS COMPANY, of Harrison, N. J., has been incorporated with a capital stock of $50,000. The incorporators are John A. Yunck, Harry H. Yunck, Millard F. Wellford, Edward G. Nessley and Joseph R. Welfong.

THE IMPERIAL CONSTRUCTION COMPANY, of Charleston, W. Va., has been incorporated to build and operate telephone, telegraph and electric light plants. The capital stock is $50,000, and the incorporators are Homer P. Dixon, E. P. Lowler, James E. Furguson, Harlan W. Gillis, all of Charleston.

OBITUARY.

JAMES A. MYERS.

MR. JAMES A. MYERS, president and treasurer of the Robbins & Myers Company, of Springfield, Ohio, died at his home in that city on May 27. He had returned on April 22 from an extended business trip and seemed at that time in the best of health. He became ill on May 7, however, and soon developed symptoms of typhoid fever which terminated fatally as noted. Mr. Myers was born at Jamestown, Ohio, in 1851, and was educated at Bowersville Academy. He went to Springfield in 1876 and engaged in business. In 1878 he became interested with Mr. Robbins in the iron foundry business, in 1889 forming the present Robbins & Myers Co., and becoming its president on the retirement of Mr. Robbins in 1900, an office he occupied at the time of his death. Mr. Myers became actively interested in electrical affairs in 1896, about which time his company entered the electrical manufacturing field. From this time his acquaintance among members of the electrical fraternity increased rapidly, until at the time of his death he numbered among them many friends in all sections of the country. Mr. Myers was quite successful in affairs and to his energetic and careful management the prominent position of his company is largely due. He leaves a wife and two sons.

EDUCATIONAL.

LECTURE ON MACHINE SHOPS.—An interesting and instructive lecture was delivered on "The Modern Machine Shop." before a large and representative audience at the Carnegie Music Hall, Pittsburg, Pa., Monday evening, May 16th, by Mr. Charles Day, of the firm of Dodge & Day, Philadelphia, Pa., under the auspices of the Carnegie Technical Schools, not the least interesting part of which was that dealing with the early history of the machine shop. The work done by such pioneers as Watt, Maudslay, Nesmyth and Whitworth was briefly reviewed and some of the original machines designed by them illustrated. The evolution up to the present day was traced through its various stages and graphically illustrated by lantern slides. Mr. Day was introduced by Mr. Frank H. Taylor, vice-president of the Westinghouse Electric & Manufacturing Company.

LEGAL.

SELF-RESTORING SWITCHBOARD DROPS.—In a communication received from Mr. James A. Keelyn, attention is called to the recent decision of the United States Circuit Court of Appeals in sustaining the patents of the Western Telephone Manufacturing Company covering self-restoring switchboard drops; the effect of which decision, it is stated, is being minimized by some patent attorneys, patent experts and manufacturers of self-restoring drop switchboards. The communication states that these patent attorneys, experts and manufacturers previously claimed that the patent would not win and that their present action is to further mislead the public.

PERSONAL.

MR. C. O. MAILLOUX, consulting engineer, Bishop Building, William Street, New York, is on a trip to Europe. He is expected to return in about a month.

MR. GEORGE WOOD BACON, of Ford, Bacon & Davis, consulting engineers, was married June 1 to Miss Caroline Tilden Mitchell at St. Cloud, Minn., the residence of the bride.

PROF. GEO. D. SHEPARDSON is represented in the current issue of the *Year Book* of the Society of Engineers, University of Minnesota, by a paper entitled "The Electrostatic Capacity of Wires."

MR. RALPH BEACH, well known in the General Electric Company, has returned to New York from a trip to Mexico, where he is very largely interested in the Tula Iron Works, whose equipment is being modernized on American lines.

MR. GORDON M. ARNOLD, brother of Mr. B. J. Arnold, president of the American Institute of Electrical Engineers, has received an appointment to West Point and successfully passed the physical and mental examinations for admission.

MESSRS. LINCH & SPROEHNLE, Pennsylvania Building, Philadelphia, have been retained as consulting and contracting engineers for the new electric railway to be constructed between Palmyra, Valley Glen and Grantville, Pa. Work will be commenced at once.

DR. LEE DE FOREST, of wireless telegraph fame, whose system is now being used so successfully by the *London Times* and *New York Times* off Port Arthur, is the subject of an appreciative sketch in the London *Daily Mail* of recent date, his portrait and apparatus being shown.

MR. F. S. PEARSON, vice-president and consulting engineer of the Mexican Light & Power Company, the Canadian syndicate which is building the huge Necaxa, Mexico City, El Oro power transmission system, is back in New York from a trip to the Southern Republic, to inspect the progress made on the work.

NOYES BROTHERS, of Perth, Australia, have been appointed engineers to the Freemantle and East Freemantle Municipal Councils to design and construct a complete system of municipal electric tramways and lighting. The estimated cost of these works is $420,000, and the system is to be ready for operation in about eighteen months.

MR. A. E. MITCHELL, formerly associated with high tension work in Denver, Col., has been appointed superintendent of motive power of the Lehigh Valley Railroad Company with headquarters at Bethlehem, Pa. He has charge of the entire specifications for the equipment of new shops at Sayre, Pa., which call for a large quantity of electrical equipment.

MR. SALVADOR UGARTE, of the Mexican electrical engineering and contracting firm of Ugarte & Garcia, of Guadalajara, State of Jalisco, which has contracts in hand for the construction and equipment of electric plants in the western part of the Southern Republic entailing an expenditure of fully $500,000 for machinery, sailed this week for Europe, but expects to be back in about three weeks, when he proposes to close contracts here for the equipment.

MR. EDWARD B. ELLICOTT, city electrician of Chicago, who has acted as constructing, electrical and mechanical engineer at the Louisiana Purchase Exposition since last December, has returned to Chicago, having practically completed his work at the Exposition, where he made a record in installing an immense amount of electrical apparatus in a very short time. The Exposition Company's electrical service construction has been well in advance of the other work.

MR. L. E. BENNETT has been appointed superintendent of construction on the extensive harbor improvements at Iloilo and Cebu, Philippine Islands, the contracts for which were recently awarded by the Government to J. G. White & Company. Mr. Bennett some time acted for the Siamese Government on the construction of the electric lighting system in Bangkok, the capital city of Siam. He also installed Yankee lighting equipment in the King's palace. He left the Government engineering bureau in Manila in order to take up his new position.

MR. MASON D. PRATT has opened an office at 18 North Third Street, Harrisburg, Pa., to do a general engineering business, including surveys, plans, etc., and construction for electric railways, power plants, etc. Mr. Pratt is a graduate of Lehigh University, and was with the Phœnix Bridge and Johnson companies. For some 13 years he was with the Pennsylvania Steel Company as street railway engineer, etc., and was in charge of the construction of a power plant for them of 1000-hp, electric sub-stations, etc.

MR. E. N. FOBES, of the Fobes Supply Company, Seattle, Wash., will be in New York next week for the purpose of placing orders for shipment July 1, 1904, March 1, 1905, for 100,000 incandescent lamps, 7000 iron-box bells, 27,000 Edison key sockets, 10,000 dry batteries, 10,000 insulator joints, 50,000 enclosed arc lamp carbons, a substantial lot of flexible and iron armored conduits and a general line of electrical supplies. While in New York he will make his headquarters in the offices at 136 Liberty Street of Mr. T. D. Watson, local representative of the Trumbull Electric Company.

MR. RUDOLPH MIEHLING, formerly New York manager of the Walker Electric Company, has connected himself with the Frank Adam Electric Company, of St. Louis, as sales manager.

MR. J. H. HALLBERG has opened offices at 45 Broadway, New York City, as a consulting electrical engineer and lighting expert. The telephone call is 4578 Broad. Mr. Hallberg has done a large amount of excellent work in late years in the lighting field.

MR. ARTHUR WARREN has an able and very interesting article in the June *American Review of Reviews* on "The Turbine: A New Era in Steam." It is written with his wonted literary skill and is well illustrated. The subject is summed up and discussed in a way that makes it thoroughly intelligible to the general public.

PROF. E. F. NICHOLS.—Professor Ernest Fox Nichols, of Columbia University, has received the Rumford gold and silver medal for marked scientific research. The honor was awarded Professor Nichols not only by the American Academy of Arts and Sciences, but also by the British Society, thus making the distinction a double one. Professor Nichols's research was directed along the lines of radiation, especially in the field of the pressure due to radiation, the heat of the stars and the infra-red spectrum. The medal will be struck off this summer, and will be presented to Professor Nichols at a special meeting of the American Academy of Arts and Sciences.

MR. MAX LOEWENTHAL, secretary and electrical engineer of the Prometheus Electric Company, has returned east from a four-months' trip in the interests of this company, having during that time visited almost every large city in the United States as far west as Denver, Col., establishing agencies for the sale of Prometheus electric heating and cooking apparatus. In the opinion of Mr. Lowenthal, after having thoroughly canvassed the situation, the immediate prospects of the electric heating business are very encouraging. In addition to an active business trip, Mr. Loewenthal enjoyed an excursion through the mining camps of Colorado and a trip to the St. Louis Exposition.

MR. PAUL M. MOWREY, who for the last three years has been connected with the Merchants' Trust Company as adviser on industrial investments, has assumed the office of vice-president of the Engineering Company of America, 74 Broadway. He has been prominently identified with the engineering and contracting business since 1888, when he became connected with the Edison Illuminating Company. Among his numerous successful enterprises was the purchase and consolidation of the street railway and power companies of Richmond, Va., which were later turned over to Mr. Frank Jay Gould.

MR. C. C. TYLER has resigned his position as superintendent of the works of the Westinghouse Electric and Manufacturing Company, at East Pittsburg, Pa., and has been appointed general superintendent of all the works of the Allis-Chalmers-Bullock interests in the United States. Mr. Tyler, who will enter upon his new duties on June 15, will make his headquarters at Milwaukee. His record in the practical management of great machine-shops is well known. Before Mr. Tyler went to Pennsylvania he made an excellent reputation, and at Pittsburg, where he has been for half dozen years, he enhanced this by the results he achieved in his work there. In the equipment of manufactories, in the design and construction of machine tools, in the handling of machinery and material in processes of manufacture, and in fact in all that pertains to the economy of machine-shop administration, Mr. Tyler is recognized as an expert who has no superior in this country. In entering upon his new field of duty, he is sure to carry with him the congratulations of the engineering profession. His appointment is another evidence of the care and strength by which the Allis-Chalmers Company organization (which, it will be remembered, now also controls the Bullock Electric Manufacturing Company) is being wrought together.

PROFESSOR A. MARSTON, who has been in charge of the civil engineering department for the last twelve years, was recently elected Dean of the Engineering Division at the Iowa State College. Professor G. W. Bissell has charge of the Department of Mechanical Engineering, Professor L. B. Spinney of the Electrical Engineering, and Professor S. W. Bayer of the Mining Engineering. The idea is to unify the work of the departments. During the last few years they have been experiencing a remarkable growth and the enrollment the present year is six hundred and seventy (670) students. This is an increase of about five hundred per cent. in seven years, and, taken in connection with the completion and occupation of the new $220,000 Engineering Hall, has brought the Division of Engineering to such a point that it seemed wise to have a more centralized organization. The engineering departments secured from the legislature a small appropriation for the establishment of an engineering experiment station to conduct experimental researches and publish bulletins helpful to the industrial interests of the State. The college also secured an appropriation of $7000 for good roads' experimentation and a law was passed by the legislature making the college a state highway commission. This work also will fall largely to the Division of Engineering, although the Agricultural Division will work in co-operation. It is the intention, among other things, to establish a summer good roads school for the benefit of road officials of the State. Professor Marston is a graduate of Cornell University, class '89.

DR. F. W. ATKINSON, the new head of the Brooklyn, N. Y., Polytechnic Institute, is a man of fine and engaging personality and already well known as an instructor. He was born on May 23, 1865, at Reading, a suburb of Boston. He graduated from the Reading High School and for four years from 1882 studied at the State Normal School, Bridgewater, Mass. Upon graduation from that institution he became principal of the Upton, Mass., High School, in which position he remained a year. Further studies were pursued at Harvard during the next three years, and in 1890 he received the degree of A. B. The following year he was in charge of the Westfield, Mass., High School. Then he went abroad to get advantage of foreign teaching, methods and experience. He studied at the Universities of Berlin, Halle and Leipsic for two years, taking the degree of Ph. D. at Leipsic. The next year he studied at Jena University and at the Sorbonne, Paris. During this stay in Europe Dr. Atkinson visited schools of all sorts in Germany, Austria and France. In 1894 he became principal of the Springfield, Mass., High School, holding the position until May 1900. In that month, on the recommendation of President Eliot, the Hon. W. T. Harris and the Hon. C. D. Wright, he was appointed by the U. S. Philippine Commission as General Superintendent of Public Instruction in the Philippine Islands. It was while he was in the Philippines that Dr. Atkinson came most prominently before the public. His service there was purely pioneer and constructive, and the educational policy adopted by the United States in the archipelago was almost entirely his in both conception and execution. In June of last year, on his return from the islands, Dr. Atkinson was immediately appointed Superintendent of Schools at Newton, Mass., which position he now holds.

Trade Notes.

THE C. J. TOERRING COMPANY has removed its offices and factory to 2318 Noble Street, Philadelphia.

THE MORRIS ELECTRIC COMPANY, of Wilmington, Del., is issuing a catalogue which runs for one year from April to March. The 1904 production contains a pretty figure, and a simple announcement of fibre specialties and fibre wiring cleats.

SMITH ELECTRIC STORAGE BATTERY.—The Smith Storage Battery Company, Binghamton, N. Y., in a circular, illustrates and describes the Smith storage battery. Several large installations of the battery, which is of the superposed tray type, are illustrated.

TELEPHONE PAY STATIONS.—With the title "A Bargain in Pay Stations," the Kellogg Switchboard & Supply Company, Chicago, is sending out an announcement of reduced prices for pay stations in order to close out the stock in hand, the manufacture of this class of apparatus having been discontinued.

THE CANADIAN WESTINGHOUSE COMPANY has issued a tasteful circular in English and French editions as to the large works it is putting up at Hamilton, Ont., to build all kinds of Westinghouse apparatus, employing, however, only Canadian labor and material. Over a thousand men will be employed.

THE RITTENHOUSE-MILLER COMPANY has removed its factory from Philadelphia to Trenton, N. J., thus increasing its facilities for the manufacture of Eureka flexible conduit, the steadily increasing demand for Eureka conduit having necessitated this change. The address of the company will henceforth be Trenton, N. J.

ELECTRIC STORAGE BATTERY LOCOMOTIVES.—The C. W. Hunt Company is sending to its friends and patrons a neatly printed invitation to make a visit when at St. Louis to its exhibit of electric storage battery locomotive and cars running on narrow gauge "Industrial" tracks with curves and switches of 12 feet radius.

MACHINERY HALL, unlike the other buildings at the St. Louis World's Fair, is not closed in the evening. It is open until 11 p. m., and visitors in the evening find at work there, among other objects of interest, the big 5000-hp Allis-Chalmers-Bullock engine and generator producing the electric current to keep aglow the 120,000 or more decorative lights which glitter all over the buildings and grounds.

THE DIALECTRIC MFG. COMPANY, of St. Louis, has issued a four-page folder on its W. D. paint, which it says is proof against rust, dampness and electrolytic action. This is a quick-drying black paint affording a permanent insulation protection to wood or metal. Another pamphlet which it has issued speaks of "dielac" which is sticking varnish; "dilectrol," which is for copper coils, and dielectric varnish, which is a baking varnish.

THE WILLIAM B. POLLOCK COMPANY, Youngstown, Ohio, builders of all kinds of steel plate construction, has installed a modern hydraulic flanging plant of the largest size built. This additional equipment enables the company to bend and form the heaviest sections of structural material as well as flange and bend plates up to 2½ inches thick. With this latest acquisition, the William B. Pollock Company's plant is all the more equipped for the erection of heavy steel plate construction for all purposes.

VOUGHT-BERGER FIRE.—On Saturday night, June 4, the factory of the Vought-Berger Company, La Crosse, Wis., was practically destroyed by fire. The fire was first discovered in the assembly rooms on the second floor of the main factory building and ruined a large portion of the work in progress in the telephone and switchboard departments. Fortunately, however, the machine shops, wood-working plant and the plating and the buffing departments were uninjured. All the buildings remained intact and the machinery, tools, dies and jigs and also raw materials and reserve stock were in no way damaged. The loss is placed in the neighborhood of $7000 or $8000. The company was, fortunately, on the verge of making many improvements and enlargements to handle the unprecedented amount of new business, and these plans will be carried out at once. The company states that the delay in shipments will be not more than a week and that absolutely no damaged material will be delivered to any of its customers.

DRY BATTERY FANS.—Electric fans have ceased to be a luxury and have become a necessity, but every house is not provided with electric current with which to run a fan. This deficiency has been met by the Jones Fan & Motor Company, 72 Vesey Street, New York, in its dry battery fan outfits. The battery and fan are made for each other, so that the best results are obtained from each. The "dry" feature of the battery commends the use of the outfit in the home, as there is no danger from spilling of chemicals, etc. The company guarantees a power-life of the battery of 250 hours with ordinary use of the fan. The battery box contains 20 cells of dry battery, and the fan, being especially designed for this combination, gives a powerful breeze. All those desiring to enjoy the comforts of a cooling breeze, but who have no electric power available to operate a fan, would do well to investigate the merits of this outfit.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 31, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

761,066. LIGHT ACCUMULATOR FOR CONTINUOUS AND ALTERNATING ELECTRIC CURRENTS; August Engelsmann, Stuttgart, Germany. App. filed Aug. 1, 1902. Details of an apparatus for focusing the light of an electric lamp upon a parabolic mirror.

761,090. HIGH TENSION ELECTRIC CONDENSER; Ignacy Moscicki, Fribourg, Switzerland. App. filed Feb. 17, 1904. The improvement consists in the parts of the dielectric which support the edges of the coatings being considerably thicker than the remaining parts covered by the coatings.

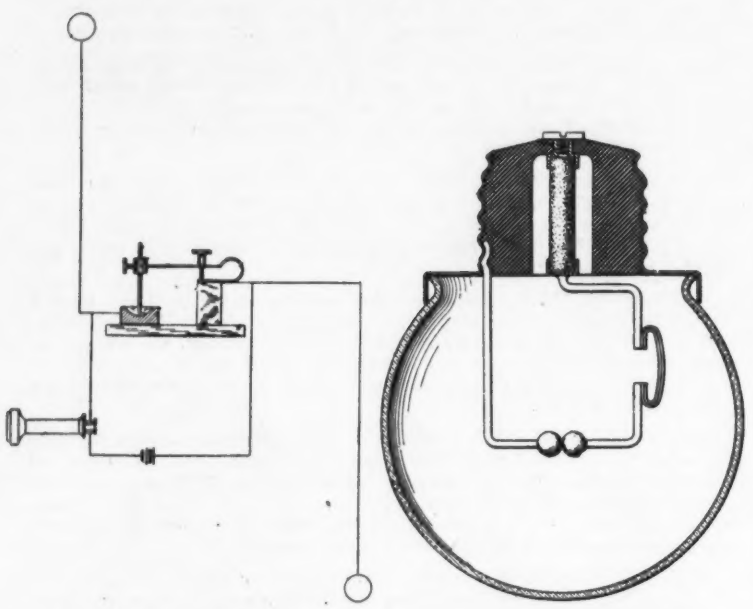
761,094. FUSE; Wm. McElroy, Brooklyn, N. Y. App. filed April 2, 1900. Means controlled by the opening of a main switch for automatically introducing one of the cut-outs into the circuit when a preceding cut-out has operated to break the circuit.

761,102. INSULATOR; Leonard M. Randolph, Newark, N. J. App. filed March 12, 1903. A base and a cap forming between them a channel for the cable and having projections in the line of the channel around which clamps are placed to hold the parts of the insulator together.

761,111. PRODUCTION OF TUBES FROM REFRACTORY MATERIAL; Elihu Thomson, Swampscott, Mass. App. filed Aug. 28, 1902. A pair of electrodes are surrounded by the refractory material in a divided state and by drawing a gradually lengthening arc the material is fused and forms a tube.

761,117. ELECTRICAL REGULATING MECHANISM; Allyn B. Walton, Lorain, Ohio. App. filed June 25, 1902. The mechanism embodies an electromagnet having two sets of poles forming two magnetic fields, one of such fields being of greater impedance than the other, in connection with a movable coil in series with the magnet coil.

761,133. ELECTRIC SWITCH; Henry P. Ball, New York, N. Y. App. filed Sept. 30, 1902. Relates to the mounting of the oil tank at the back of the switchboard and the construction of the operating mechanism connected therewith.



761,450.—System of Telegraphy. 761,380.—Electric Arc Lighting.

761,134. AUTOMATIC SHORT CIRCUIT ALARM FOR ELECTRICAL GAS LIGHTING OR OTHER SYSTEMS; Ferdinand M. Barrell, Brooklyn, N. Y. App. filed June 15, 1903. Details.

761,150. TELEPHONE ATTACHMENT; George A. Cowgill, Euphemia, Ohio. App. filed July 16, 1903. (See page 1125.)

761,182. ELECTRIC ARC LAMP; Joseph A. Rignon, Berlin, Germany. App. filed Aug. 21, 1902. Details.

761,198. HEAT ACTUATED ALARM SYSTEM; Charles E. Buell, Camden, N. J. App. filed May 28, 1903. Details.

761,199. APPARATUS FOR PRODUCING AN ALTERNATING MAGNETIC FIELD FOR THERAPEUTIC PURPOSES; Ernst Buhtz, Berlin, Germany. App. filed Jan. 30, 1904. Two or more magnets arranged about a common shaft, the lines of force passing between their poles producing on rotation of the apparatus a vortex of lines of force which is said to improve the therapeutic properties of the magnetic field.

761,204. METHOD OF MAKING ELECTRICAL HEATING APPARATUS; Charles E. Carpenter, New York, N. Y. App. filed Nov. 20, 1902. The insulating material while in a molten state is compressed between two metal plates, the heating conductor being at the same time embedded in the material.

761,205. ELECTRICAL HEATING APPARATUS; Charles E. Carpenter, New York, N. Y. App. filed Jan. 27, 1904. The apparatus patent conforming to the method described in the preceding patent.

761,208. RAILWAY SIGNAL; John P. Coleman, Edgewood, Pa. App. filed Sept. 4, 1903. The signal is operated pneumatically from a distance by electro-magnetic apparatus.

761,230. WEATHERPROOF POLE SWITCH; Chester H. Jackson, Portland, Me. App. filed May 29, 1903. Details.

761,250. ELECTRIC HEATER; Edwin F. Porter, Boston, Mass. App. filed Oct. 17, 1898. A heating conductor is wrapped around the blades of an electric fan.

761,256. WIRELESS TELEGRAPHY; Charles K. Salisbury, Lincoln Township, Blackhawk County, Ia. App. filed Oct. 30, 1902. Means for sending two or more messages simultaneously to an equal number of stations and means for utilizing relays for sending messages to stations outside of the electrical influence of the transmitting station.

761,258. WAVE RECEIVER; Richard W. Shoemaker and Lawsen H. Giddings, Pasadena, Cal. App. filed May 2, 1902. The receiver is susceptible to the electrical waves continuously, the susceptibility not being destroyed after each wave is received; the receiver consists of a conducting medium comprising particles of conducting material mixed with particles of non-conducting material.

761,267. MAGNETO; Walter F. Taylor, Brookline, Mass. App. filed Feb. 19, 1904. A polished finishing plate is placed over a coating of protecting material applied to the outer surface of the magnet.

761,280. POTENTIAL INDICATOR FOR HIGH VOLTAGE CIRCUITS; Jonathan E. Woodbridge, Albany, N. Y. App. filed Oct. 30, 1902. By inserting condensers in the leads between the main lines and the instruments, it is rendered safe to operatives to mount the instruments upon the switchboards.

761,284. REDUCTION OF NITRO COMPOUNDS; Max Buchner, Mannheim, Germany. App. filed Dec. 13, 1902. (See page 1125.)

761,308. TROLLEY WHEEL GUARD; Curtis W. Leslie, Pittsburg, Pa. App. filed Nov. 5, 1903. Details.

761,310. PREPARATION OF AZO DYES; Walther Loeb, Bonn, Germany. App. filed March 16, 1903. (See page 1125.)

761,345. STORAGE BATTERY; Theodore A. Willard, Cleveland, Ohio. App. filed Sept. 11, 1903. (See page 1125.)

761,360. ELECTROPNEUMATIC BRAKE; John W. Cloud, London, Eng. App. filed Sept. 30, 1901. An ordinary automatic air brake system with means whereby it can be actuated when necessary by electrically controlled valves.

761,372. PORTABLE ELECTRIC GAS LIGHTER; Edwin R. Gill, New York, N. Y. App. filed Jan. 4, 1902. Details.

761,379. ELECTRIC ARC LAMP; John A. Heany, York, Pa. App. filed Dec. 4, 1903. An arc lamp operating on the principle of the Nernst lamp, the electrodes being non-conducting when cold and an initial current serving to heat them up and at the same time separate them to strike the arc.

761,380. ELECTRIC ARC LIGHTING; John A. Heany, York, Pa. App. filed Feb. 4, 1904. The method corresponding to the previous patent.

761,417. SAFETY APPARATUS FOR USE ON RAILWAY CARS; Sidney H. Short, London, England. App. filed Feb. 11, 1902. In case the insulation of the trolley pole and base breaks down, an alarm is automatically sounded so that passengers on the roof of the car may be removed before any one comes in contact with the trolley pole.

761,432. COLLECTOR FOR THIRD RAIL SYSTEMS; Aldred K. Warren, New York, N. Y. App. filed Feb. 25, 1903. The shoe being at the end of a pivoted arm, is electrically connected with the car circuit by a flexible conductor wound around the axis of the arm.

761,450. SYSTEM OF TELEGRAPHY; John L. Creveling, New York, N. Y. App. filed April 11, 1903. The receiving device is a conducting bath, which is normally of high resistance, but which by electrolysis becomes of lower resistance on the passage of the received wave, and thus affects the local circuit, including the receiving device.

761,454. MANUAL AND AUTOMATIC CIRCUIT CONTROLLER; Wm. L. Denio, Rochester, N. Y. App. filed Jan. 20, 1904. Details.

761,459. SYSTEM FOR OPERATION OF MAGNETIC CLUTCHES; Arthur C. Eastwood, Cleveland, Ohio. App. filed Jan. 14, 1904. Means whereby the clutch magnets are strongest at the time of completing the circuit through them and while the load is being accelerated, the current being afterwards economized and preventing over-heating of the clutch.

761,466. ELECTRIC CUT OUT; Philip H. Fielding, New York, N. Y. App. filed Oct. 10, 1903. A double-pole cut-out in which the switch members are located in deep grooves or cavities in the face of an insulating block, the circuit closing member itself being an inclosed fuse of ordinary type which is readily removed when destroyed and substituted by another.

761,490. SAFETY DEVICE FOR ELECTRIC INTERLOCKING OR BLOCK SIGNALING APPARATUS; Frederick T. Hollins, Leytonstone, Eng. App. filed Feb. 18, 1901. A current-arrester is placed upon the circuits to prevent stray high-tension currents from getting on to the signal circuits.

761,526. INSULATED RAIL JOINT; James C. Mock, Detroit, Mich. App. filed Oct. 26, 1903. A heavy section of rail is fixed to the side of a main rail so that its upper surface will be flush therewith and afford a contact surface for the car wheel for signaling purposes.

761,533. SPRING CLIP; John S. McKee, Pittsburg, Pa. App. filed Oct. 17, 1903. In a switch where two blades connect with the clips at each pole, the intermediate clips are made shorter than the other clips to prevent an arc from forming and melting the inner surfaces of the blades, producing thereon a blister which would prevent the blade from entering the clip.

761,536. AUTOMATIC CAR SWITCH; Morris Nuss, Philadelphia, Pa. App. filed Sept. 25, 1903. Details.

761,549. ELECTRIC RAILWAY CROSSING; Abraham A. Shobe and William Embley, Jerseyville, Ill. App. filed Sept. 26, 1903. A cast box containing insulating material in which the crossing conductors are embedded and from which the latter project to engage with the conductors approaching the crossing.

761,553. THIRD RAIL SUPPORT; Louis Steinberger, New York, N. Y. App. filed Dec. 7, 1903. The insulator upon which the third rail rests contains a conical cavity into which a supporting pin projects, affording certain lateral free movement of the insulator on its support.

761,563. SWITCH FOR ELECTRIC LAMPS; Charles Wager, New York, N. Y. App. filed Aug. 22, 1903. Details.

761,565. TROLLEY MECHANISM; John H. Walker, Lexington, Ky. App. filed July 29, 1903. Details of construction whereby a flexible conductor is connected between the trolley base and pole.

761,566. TROLLEY; John H. Walker, Lexington, Ky. App. filed July 29, 1903. Details.

761,567. TROLLEY; John H. Walker, Lexington, Ky. App. filed Dec. 24, 1903. In addition to the wheel a sliding shoe is provided and mounted to the rear of the wheel in a pivoted yoke.

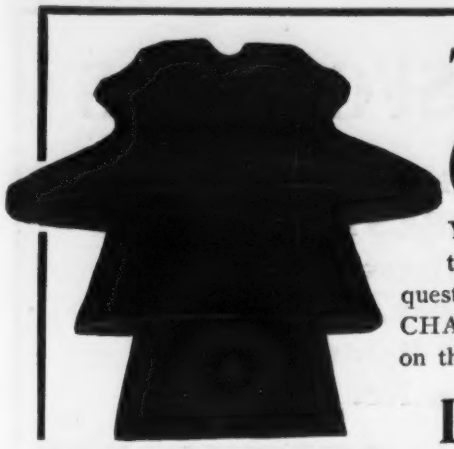
761,572. ELECTRIC FIRE AND BURGLAR ALARM; Wm. C. Barger, Mammoth, W. Va. App. filed March 31, 1904. Details.

761,574. TROLLEY PROTECTOR; John H. Best, Jr., Sandusky, Ohio. App. filed Jan. 8, 1904. Details.

761,611. TROLLEY POLE; Charles F. Ritchel, Bridgeport, Conn. App. filed Sept. 17, 1903. The wheel is mounted in an extension to the pole which is connected therewith by a vertical axis permitting lateral play of the wheel with respect to the pole.

761,616. SELECTIVE PARTY-LINE TELEPHONE SYSTEM; Albert J. Springborn, Cleveland, Ohio. App. filed June 27, 1902. (See page 1125.)

761,636. AUXILIARY FIRE ALARM SYSTEM; Wm. L. Denio, Rochester, N. Y. App. filed Jan. 20, 1904. Details.



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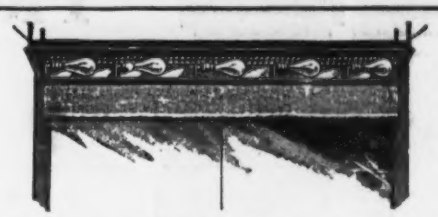

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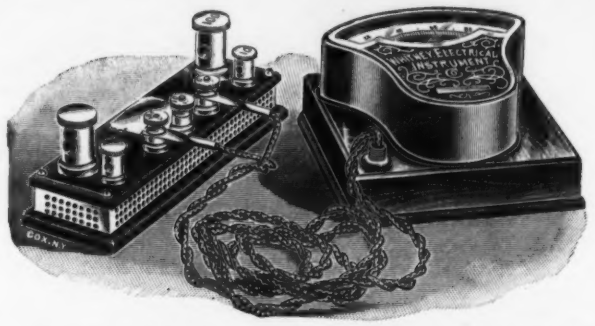

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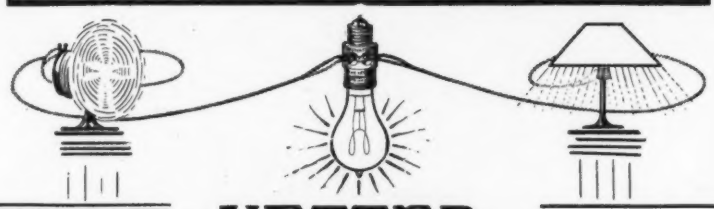

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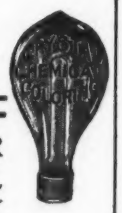

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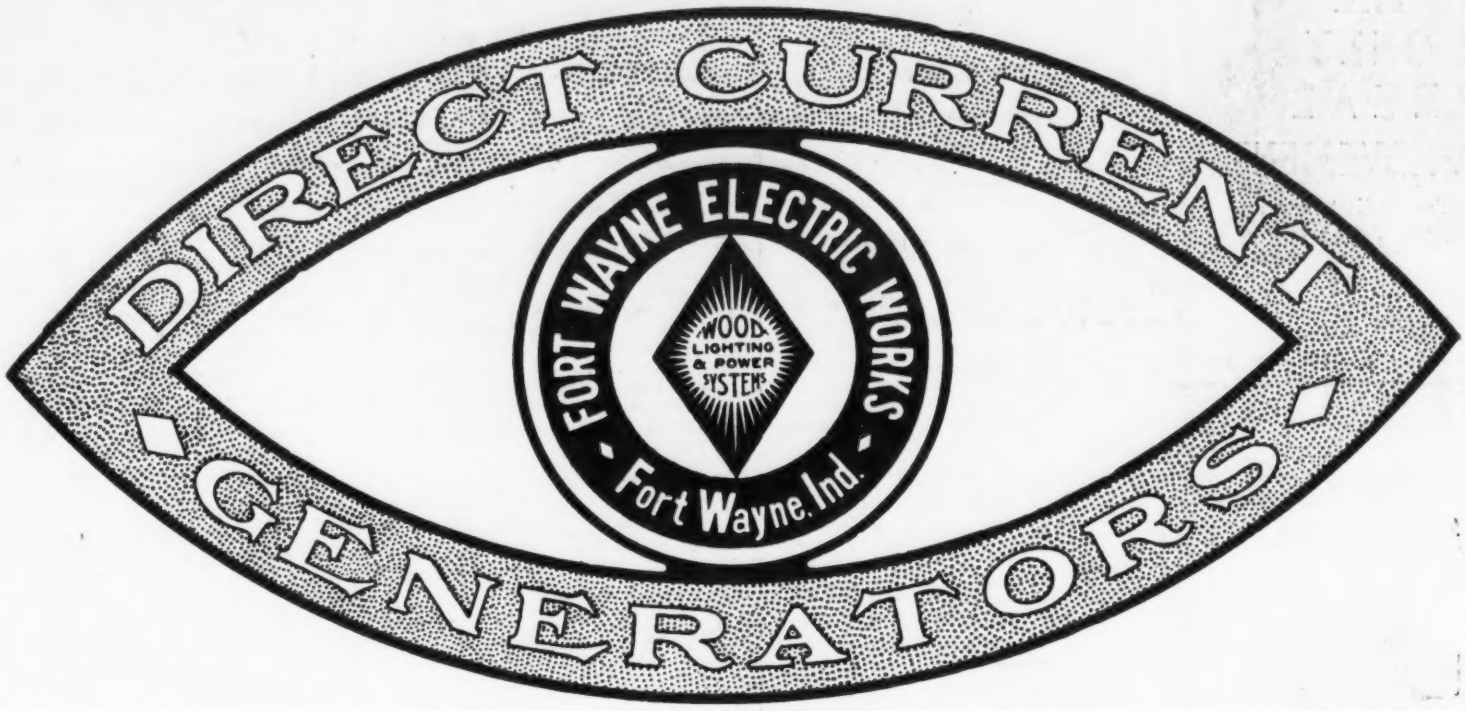

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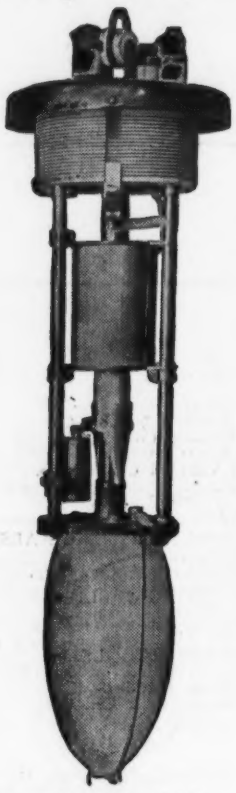

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Dixon Crucible Co., Jos.

GREASE.
Dixon Crucible Co., Jos.

HACK SAWS.
Smith, Hemenway & Co., Corp.

HANGER BOARD.
Ft. Wayne Electric Works.

HARD RUBBER, PERFORATED.
Aitchison Perforated Metal Co., Robert

HEATING APPARATUS.
Sturtevant Co., B. F.

Continued on Page 40.

TRANSFORMERS

With The Lakon Improved Hanger.

For any voltage or frequency. High potential testing transformers.
Step up and step down transformers, for long distance transmission.

VENTILATED TYPE. **OIL TYPE.**

THE LAKON COMPANY,

ELKHART. INDIANA, U. S. A.

DALE'S WIRELESS CLUSTER
With Switch Attached.

DALE'S Wireless Clusters

Patented April 19th, 1904. **Multiple or Series.**

YOUR LOSS If you have not seen them.
After you have seen them YOU WILL BUY them.

Cheaper than a CLUSTER requiring sockets.
Simpler and better than any other make on the market.
Passed by underwriters.
Can be installed instantly.

NOT NECESSARY TO REMOVE RINGS TO CONNECT UP.

NO porcelain base used—thus eliminating possibility of BREAKAGE.

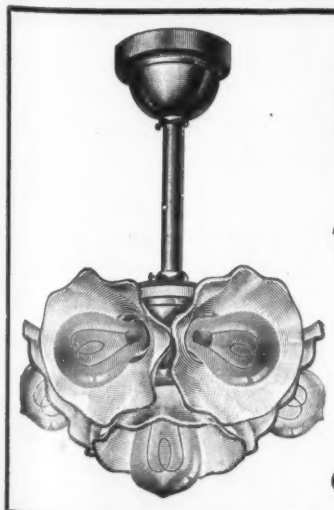
Fastened to or suspended from ceiling WITHOUT use of tripod.

Packed ONE in a box—ABOUT HALF THE WEIGHT of other wireless clusters.

Prices and discounts on application

DALE'S WIRELESS CLUSTER
With Ceiling Flange and Shade Holder for Low Ceiling Work.

The Dale Company, New York



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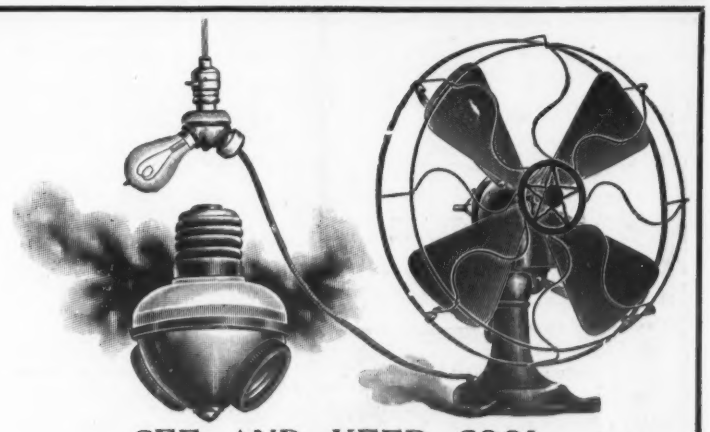
WIRELESS CLUSTERS
Benjamin Electric Mfg. Co.
CHICAGO NEW YORK



SEE AND KEEP COOL.
You are not a NOVICE, but if you were you could make this connection.

DOUBLEDAY-HILL ELECTRIC CO.
PITTSBURG, PA.

4 CARLOADS
OF STOCK

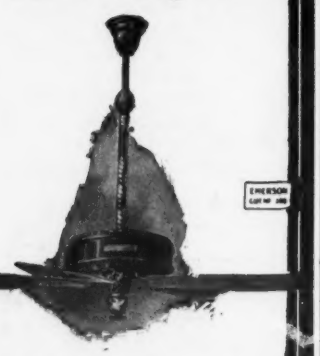
EMERSON ALTERNATING FANS

Better Than Ever This Season.

Desk or Bracket Type
Automatic Start

The most durable and efficient fan made

4-Blade Ceiling Fan



Electrical Supplies
HIGHEST GRADE
LOWEST PRICE
QUICKEST DELIVERIES

DOUBLEDAY-HILL ELECTRIC CO.
PITTSBURG, PA.

CLASSIFIED INDEX.—*Continued from Page 38.*

HEATING BY EXHAUST STEAM.
American District Steam Co.

HOISTS, ELECTRIC AND STEAM.
Case Mfg. Co.
Jeffrey Mfg. Co.
Muralt & Co.
Pawling & Harnischfeger.
United Telpherage Co.

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Yale & Towne Mfg. Co.

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Pelton Water Wheel Co.

ICE-MAKING MACHINERY.
Vilter Mfg. Co.

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Carlisle & Finch Co.
Holtzer-Cabot Elec. Co.

INDUCTION COILS.
International Brass & Elec. Co., Inc.
Ostrander & Co., W. R.
Splitdorf, C. F.
Varley Duplex Magnet Co.

INSULATING STAPLES.
Blake Signal & Mfg. Co.

INSULATORS AND INSULATING MATERIAL.
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American Vulcanized Fibre Co.
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Bellevue Porcelain Works.
Bissell Co., F.
Bourn Rubber Co.
Calman Co., Emil.
Compressed Fibre Co.
Connolly Bros., Ltd.
Crescent Insulated Wire & Cable Co.
Delaware Hard Fibre Co.
Dielectric Mfg. Co.
Driver-Harris Wire Co.
Empire China Works.
Ft. Wayne Electric Works.
Hartford Faience Co.
Hemingray Glass Co.
Hope Webbing Co.
Imperial Porcelain Works.
Johns-Manville Co., H. W.
Kartavert Mfg. Co.
Kruesi, P. J.
Locke Insulator Mfg. Co.
Magnet Wire Co.
Mica Insulator Co.
Murdock, H. D.
Munsell & Co., Eugene.
Mustard, John.
National Wire Corporation.
New England Butt Co.
Pass & Seymour, Inc. (China).
Ryle & Co., Wm. (Silk).
Safety Insulated Wire & Cable Co.
Scranton Button Co.
Siemon Hard Rubber Corporation.
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Standard Underground Cable Co.
Standard Vitrified Conduit Co.
Sterling Varnish Co.
Steward Mfg. Co., D. M.
Sunlight Lava Mfg. Co.
Thomas & Sons, R.
Trenton Porcelain Co.
United Button Co.
Vulcanized Fibre Co.
Waterbury & Co.

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Watson-Stillman Co.

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D. & W. Fuse Co.
General Incandescent Arc Light Co.
Johnson & Morton.
Sarco Company.

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Incan. Electric Lt. Manip. Co.

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Allgemeine Elektricitats Gesellschaft.
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Anderson Mfg. Co., A. & J. M.
Bissell & Co., F.
British Thomson-Houston Co.
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Doubleday-Hill Elec. Co.
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General Electric Co.
General Incandescent Arc Light Co.
Gregory Electric Co.
Helios Mfg. Co.
Keystone Electric & Mfg. Co.
Stanley Electric Mfg. Co.
Warner, W. F.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

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Lippincott Glass Co.

LAMP COLORING COMPOUND.
Signaloid Chemical Wks.
Webster Chemical Co.

LAMP HOLDERS.
Crescent Co.

LAMPS, INCANDESCENT.
Crescent Co.

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Brilliant Electric Co.
British Thomson-Houston Co.
Brush Elec'l Engineering Co.
Bryan-Marsh Co.
Central Elec. Co.
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Economical Electric Lamp Co.
Edison Dec. & Min. Lamp Co.
General Electric Co.
General Incandescent Arc Light Co.
Germania Elec. Lamp Co.
Machado & Roller.
Missouri American Elec. Co.
New York & Ohio Co.
Sawyer-Man Electric Co.
Standard Electrical Mfg. Co.
Sterling Elec'l Mfg. Co.
Tipless Lamp Co.
Western Electric Co.

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American Endoscopic Co.
Edison Dec. & Min. Lamp Co.
Jaeger Min. Lamp Co.

LAMPS, NERNST.
Nernst Lamp Co.

LAMPS, REGULATING.
Economical Electric Lamp Co.

LAMP REPLACERS.
Incan. Electric Lt. Manip. Co.

LATHES.
Barnes Co., W. F. & John.
Garvin Mch. Co.
Hardinge Bros.
Sebastian Lathe Co.
Seneca Fall Mfg. Co.

LETTERS FOR ELECTRIC SIGNS.
Electric Motor & Equipment Co.
Haller Machine Co.
Western Display Co.

LINEMEN'S TOOLS.
Bissell Co., F.
Cincinnati Tool Co.
Klein & Son, Mathias.
Smith, Hemenway & Co., Corp.
Utica Drop Forge & Tool Co.

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Cook, Frank B.
D. & W. Fuse Co.
Garton-Daniels Co.
Muralt & Co.
Stanley Elec. Mfg. Co.
Viaduct Mfg. Co.
Westinghouse Elec. & Mfg. Co.

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Lunkenheimer Co.

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Bement, Miles & Co.
Garvin Mch. Co.
Niles Tool Works Co.
Perkins Machine Co.
Pond Machine Tool Co.
Pratt & Whitney Co.
Sebastian Lathe Co.
Seneca Falls Mfg. Co.
Watson-Stillman Co.

MARINE ELECTRIC EQUIPMENT.
Electro-Dynamic Co.
Kilbourne & Clark Co.

MAST ARMS.
Brady, T. H.

MEDICAL APPARATUS.
Pignolet, Louis M.
Splitdorf, C. F.

METALS.
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Baker & Co., Inc.
Croselmire & Ackor.
Diamond Anti-Friction Metal Co.
Leslie & Co., A. C.
Phosphor Bronze Smelting Co.

METAL LETTERS.
Haller Machine Co.

METAL, PERFORATED.
Aitchison Perforated Metal Co., Robert.

METAL POLISH.
Allen Co., Inc., L. B.
Hoffman, George W.

MICA.
Johns-Manville Co., H. W.
Mica Insulator Co.
Munsell & Co., Eugene.
Schoonmaker, A. O.
Sills-Eddy Mica Co.
Vance, D. T.

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Pratt & Whitney Co.

MINING MACHINERY.
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Jeffrey Mfg. Co.
Muralt & Co.
Power & Mining Machinery Co.

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Baillard, E. V.
International Brass & Electric Co., Inc.
Parsell & Weed.

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Standard Paint Co.

MOULDING.
K. & B. Company.

NAME PLATES.
Becker Eng. Co., A.
New York Steel & Copper Plate Co.

NIPPERS AND PLYERS.
Cincinnati Tool Co.
Smith, Hemenway & Co., Corp.
Utica Drop Forge & Tool Co.

NON-MAGNETIC WATCHES.
Becken, A. C.

NOZZLES.
McCullough-Dalzell Crucible Co.

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NUMBERING AND DATING MACHINES.
Bates Machine Co.

NUTS.
International Brass & Elec. Co.
National Acme Mfg. Co.

OIL.
Kellogg & Co., E. H.

OIL AND GREASE CUPS.
Bay State Stamping Co.
Crane Co.
Lunkenheimer Co.

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Burt Mfg. Co.

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Chicago Fuse Wire & Mfg. Co.
Bossert Electric Construction Co.
Sarco Company.

OVERHEAD RAILWAYS.
United Telpherage Co.

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Jenkins Bros.
Johns-Manville Co., H. W.
Peerless Rubber Mfg. Co.

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Calman & Co., Emil.
Mustard, John.
Standard Paint Co.
Sterling Varnish Co.

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Byrnes & Townsend.
Dyer & Dyer.
Goepel & Niles.
Rosenbaum & Stockbridge.
Townsend & Decker.

PHOTOMETER STANDARDS.
Electrical Testing Laboratories.

PHOSPHOR BRONZE.
Phosphor Bronze Smelting Co.

PHOSPHORIZERS.
McCullough-Dalzell Crucible Co.

PINIONS.
New Process Raw Hide Co.

PLATINUM.
American Platinum Works.
Baker & Co., Inc.
Croselmire & Ackor.

PLUGS.
Paiste Co., H. T.

PLUMBAGO.
McCullough-Dalzell Crucible Co.

POLES, TIES, BRACKETS, PINS, ETC.
Bissell Co., F.
Brady, T. H.
Eastern Arm & Pin Co.
Eccleston Lumber Co.
K & B Company.
Kellogg S. B. & Supply Co.
Lindsley Bros. & Co.
Phelan, D. W.
Porter Cedar Co.
Sterling & Son, W. C.
Strock, S. C.
Valentine-Clark Co.
Va. Locust Pin Co.
Worcester Co., C. H.

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Bellevue Porcelain Works.
Empire China Works.
Hartford Faience Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Mustard, John.
Pass & Seymour, Inc.
Thomas & Sons, R.
Trenton Porcelain Co.

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Case Mfg. Co.
Jeffrey Mfg. Co.
Hunter Machine Co., James.
Link-Belt Engineering Co.
Muralt & Co.
Niles Tool Works Co.

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Bement, Miles & Co.
Hunter Machine Co., James.
Perkins Machine Co.
Pond Machine Tool Co.
Watson-Stillman Co.

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Hunter Machine Co., James.
Jeffrey Mfg. Co.
Niles Tool Works Co.
Smith Co., S. Morgan.

PUMPS, ELECTRIC.
Commercial Electric Co.
Emerson Elec. Mfg. Co.
Quimby, Wm. E.

PUMPS, OIL.
Lunkenheimer Co.

PUMPS, STEAM.
McGowan Co., J. H.
Quimby, Wm. E.

PUMP VALVES, RUBBER.
Crosby Steam Gage and Valve Co.

PUNCHES AND SHEARS.
Bement, Miles & Co.

PUSH BUTTONS.
Edwards & Co.
Sarco Company.

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WILL NOT SOFTEN IN HOT WEATHER AND WILL NOT CRACK IN COLD. WE HAVE A LARGE STOCK ALWAYS ON HAND, OUR PRICES ARE RIGHT AND WE SHIP PROMPTLY.

MAY WE NOT SEND YOU A SAMPLE CARD?

Central Electric Company GENERAL WESTERN AGENTS. 264-266-268-270 FIFTH AVENUE, CHICAGO

CLASSIFIED INDEX—*Continued from Page 40.*

Pond Machine Tool Co.
Pratt & Whitney Co.

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Roebling's Sons Co., J. A.

RAILWAY SUPPLIES (Electric).
Brush Elec'l Engineering Co.
General Elec. Co.
Johns-Manville Co., H. W.

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Carlisle & Finch Co.

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Pollock Co., Wm. B.

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New Process Raw Hide Co.

RECEPTACLES.
Benjamin Elec. Mfg. Co.
Dale Company.
Electro Dynamic Co.
General Incandescent Arc Light Co.
Paiste Co., H. T.
Trumbull Elec. Mfg. Co.

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Dale Company.
Frink, I. P.
Holophane Glass Co.
National X-Ray Reflector Co.
Phœnix Glass Co.
Sarco Company.
Sunlight Reflector Co.

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Vilter Mfg. Co.

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Elliott Bros. Elec. Co.
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Heck, Louis.
Northwestern Electric Co.

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Wirt Electric Co.

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Hart Mfg. Co.
Pass & Seymour, Inc.
Trumbull Elec. Mfg. Co.

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Allen Co., L. B.
Klipstein & Co., A.
Roessler & Hasslacher Chem. Co.

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Richardson Scale Co.

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Electrical Engineer Inst. of Correspondence Inst.
International Correspondence Schools.
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Pratt Institute.
Rose Polytechnic Institute.

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Bogue, Charles J.
Carlisle & Finch Co.
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Rushmore Dynamo Works.

SECOND-HAND APPARATUS.
Bender, George.
Bissell & Co., F.
Garvin Mch. Co.
Gregory Electric Co.
Jordan Bros.
Northwestern Electric Co.
Rossiter, MacGovern & Co.
Schoonmaker Co., A. C.
Station Equipment Co.
Thompson-Bonney Co.
Whitehead Machinery Co.

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J-E-M Shade Holder Co.

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Ryle & Co., Wm.

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Electric Motor & Equipment Co.
Haller Machine Co.
Western Display Co.

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Monson Burmah Slate Co.

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Federal Electric Co.
General Electric Co.
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Paiste Co., H. T.
Pass & Seymour, Inc.
Trumbull Elec. Mfg. Co.

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Allen Co., L. B.
Crescent Company.
Green & Co., W.

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Westinghouse, Church, Kerr & Co.

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Electrical Equip. & Supply Co.
Empire Electric Supply Co.
General Electric Co.
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Kilbourne & Clark Co.
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Manhattan Elec'l Supply Co.
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Stuart-Howland Co.
Warner, W. F.
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Bissell Co., F.
Bossert Electric Const. Co.
British Thomson-Houston Co.
Clark Automatic Tel. S. B. Co.
Condit Elec'l Mfg. Co.
Crouse-Hinds Co.
Electro-Dynamic Co.
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Haas Elec. & Mfg. Co., R.
Johnson & Morton.
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Muralt & Co.
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Sterling Electric Co.
Sundh Electric Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.

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Bissell & Co., F.
Bossert Elec. Const. Co.
Chase-Shawmut Co.
Condit Elec'l Mfg. Co.
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Crouse-Hinds Co.
Cutter Electrical & Mfg. Co.
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General Electric Company.
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Johnson & Morton.
La Roche Co., F. A.
Muralt & Co.
Sterling Electric Co.
Sundh Electric Co.
Trumbull Elec. Mfg. Co.

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La Roche Co., F. A.

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Pollock Co., Wm. B.

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Manhattan Electrical Supply Co.
Mica Insulator Co.
Okonite Co.
Standard Paint Co.

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Pratt & Whitney Co.

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American Electric Telephone Co.
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Automatic Elec. Co.
Bissell Co., F.
Clark Automatic Tel. S. B. Co.
Clark Tel. & Tel. Co., Thos. F.
Couch Co., S. H.
Holtzer-Cabot Elec. Co.
International Tele. Mfg. Co.
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Manhattan Elec'l Supply Co.
Murdock, H. D.
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Russell-Tomlinson Elec. Co.
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Viaduct Mfg. Co.
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New York Telephone Co.

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Holtzer-Cabot Elec. Co.
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North Electric Co.
Russell-Tomlinson Elec. Co.
Scranton Button Co.
Siemon Hard Rubber Corporation.
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Electrical Testing Laboratories.

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Ward Leonard Electric Co.
Wirt Electric Co.

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Calculagraph Co.

TIME SWITCHES.
Hartford Time Switch Co.

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Crooke Co., John L.

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Muralt & Co.

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TUBULAR DISPATCH.
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Westinghouse Machine Co.

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Crosby Steam Gage & Valve Co.
Jenkins Bros.
Lunkenheimer Co.

VISES.
Utica Drop Forge & Tool Co.

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Electric Specialty Co.

VULCABESTON.
Johns-Manville Co., H. W.

VULCANIZED FIBRE.
Vulcanized Fibre Co.

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Leffel & Co., James.
Pelton Water Wheel Co.
Smith Co., S. Morgan.

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Risdon-Alcott Turbine Co.
Sturgess Governor Eng'ring Co.
Woodward Governor Co.

WEBBING.
Hope Webbing Co.

WINDING MACHINERY.
American Insulating Machinery Co.

WINCHES, SAFETY.
Yale & Towne Mfg. Co.

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National Elec. Signalling Co.

WIRES AND CABLES.
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American Insulated Wire & Cable Co.
Ansonia Brass & Copper Co.
Atlantic Insulated Wire & Cable Co.
Bishop Gutta Percha Co.
Bourn Rubber Co.
Bridgeport Brass Co.
Central Electric Co.
Chicago Insulated Wire Co.
Connolly Bros., Ltd.
Crescent Insulated Wire & Cable Co.
Driver-Harris Wire Co.
Electric Appliance Co.
Hazard Mfg. Co.
Indiana Rubber & Ins. Wire Co.
India Rubber & G. P. Ins. Co.
Magnet Wire Co.
Montauk Fire Detecting Wire Co.
Moore, A. F.
National Conduit & Cable Co.
National India Rubber Co.
National Wire Corporation.
New York Insulated Wire Co.
Okonite Co., The.
Roebling's Sons Co., J. A.
Safety Insulated Wire & Cable Co.
Simplex Electrical Co.
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Waterbury & Co.

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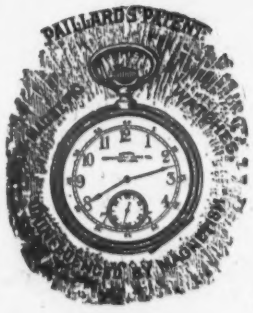

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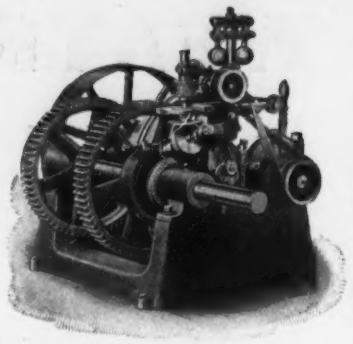

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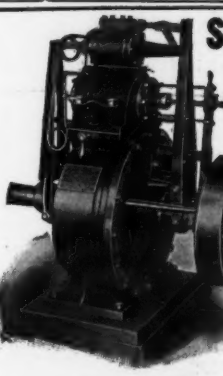

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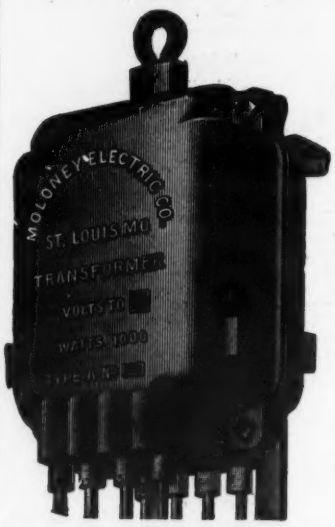

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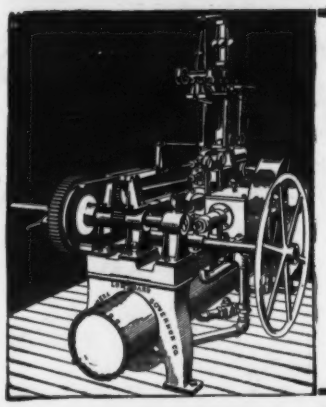

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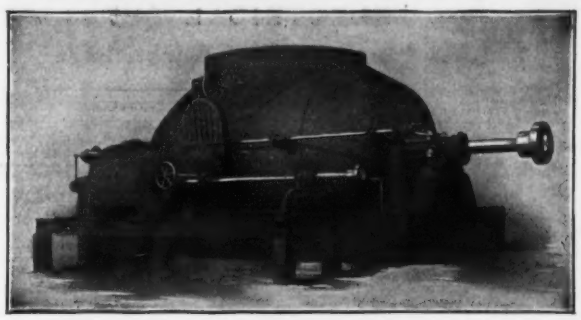

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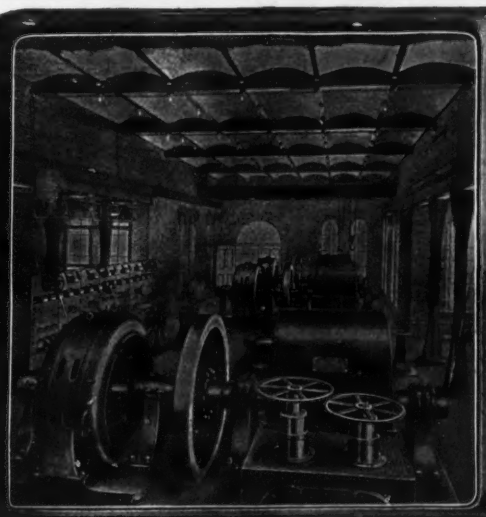

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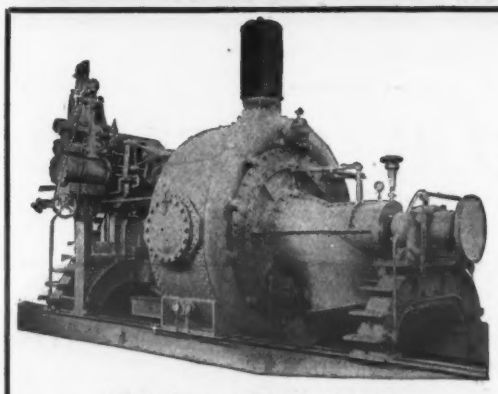

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The illustration shows the large NIAGARA design, HORIZONTAL SHAFT TURBINES recently installed by us, for the NIAGARA FALLS HYDRAULIC POWER & MFG. CO., Niagara Falls, N. Y. Tests conducted by competent engineers developed as follows:

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213 ft.	½	257 r.p.m.	1750	95%	.730%
213 "	¾	257 "	3000	95%	.856%
213 "	Full	257 "	3500	95%	.815%

These results have never been equalled by any turbine of the Horizontal Shaft Design, operating under equally HIGH HEADS. The test was made AFTER TURBINES WERE INSTALLED, direct coupled to Generators. Francis' weirs and formulæ for discharge were used. The original test reports on file at our offices. These turbines are all fitted with our SAMSON BALANCED GATES. Note especially the UNIFORM SPEED at ALL GATEAGES.

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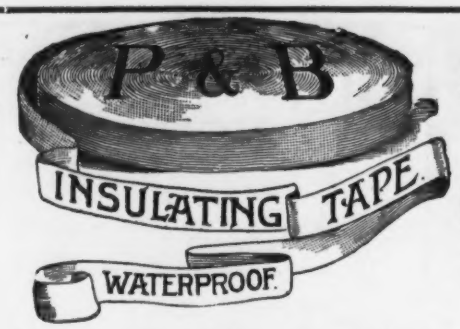

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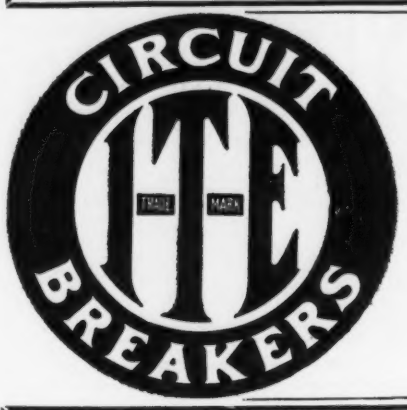

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